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MACHINERY

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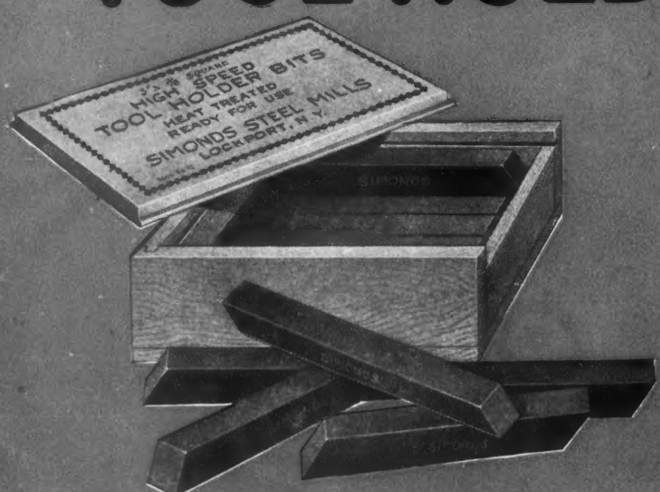

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MACHINERY

JULY, 1922 VOL. 28 NO. 11

Approved Methods of Grinding Such Important Parts as Pistons, Piston-rings, Piston-pins, Cylinders, Connecting-rods, Crankshafts, Camshafts, Gear Teeth and Spline Shafts

First Installment of a Series of Five Articles on Grinding in Different Industries, by the Engineering and Educational Departments of the Norton Company, of Worcester, Mass.

Grinding in the Automotive Industry

THE automotive and allied industries, including the manufacture of automobiles, motorcycles, trucks, airplanes, tractors, ball and roller bearings, universal joints, and transmissions, consume more grinding wheels than all other industries combined. In the automotive industry, interchangeable manufacture is of particular importance, and as small tolerances are allowed for most of the parts, grinding is the only economical method of producing them. Another reason for the extensive application of grinding in this field is that a large number of hardened steel parts are used. Hardened work can be machined commercially only by grinding. Almost every part is ground at some stage of its manufacture, and in many cases grinding is by far the most important operation.

There are many automotive parts that are simple cylindrical pieces ground on the ordinary type of cylindrical grinding machine, there being nothing unusual about the operation. This class includes such parts as push-rods, pump shafts, shackle bolts, pins, and bushings. Bushings are also ground internally on standard internal grinding machines, the operation being simple and not of special interest. There are, however, many grinding operations that are characteristic of the automotive industry, and that represent interesting examples of grinding practice, and these will be dealt with in this and in a second article to appear in August MACHINERY.

Fig. 1. Cylindrical Grinding Operation on Pistons

Pistons, such as are used in the automotive industry, are made from either cast iron or aluminum. The grinding of cast-iron pistons will be considered first. The important operation is cylindrical grinding (see Fig. 1). This follows a rough-turning operation in which the castings are turned to within about 0.025 inch of the finished size. The piston is held on a special fixture, which makes it possible to grind the entire length with one set-up of the machine. Three types of these special fixtures are illustrated in Fig. 2. The construction will be readily understood by referring to this illustration in connection with the description.

The grinding fixture shown at *A* has a conical-shaped part (made of cast iron), which is mounted on the hardened taper bearing of a dead center, and is revolved by the face-plate driving pin. This conical casting carries three equally spaced jaws which may be adjusted along dovetail slots to suit the diameter of the piston that is to be ground. Each jaw is split lengthwise, and has a taper screw which spreads it in the slot for locking in any position. A notch in each jaw provides clearance for the grinding wheel, as the illustration shows. The dead center which supports the conical-shaped chuck is inserted in the main spindle of the grinding machine.

The fixture shown at *B* is very simple; it consists of a steel disk-shaped part for supporting the open end of the piston, with a driving pin that engages

one of the wrist-pin bosses, and another pin that engages the driving pin on the machine faceplate. In this case, as in the preceding one, the regular machine center is used for supporting the outer end of the piston.

A third design of fixture is shown at *C*. A loose pin is inserted in the wrist-pin holes so that it extends across the piston and through an elongated hole in the central arbor. After the back-plate is placed in the open end of the piston, the taper drift key is driven in, thus holding the parts firmly together. This simple method of holding a piston has proved very effective.

In grinding pistons, the "draw-in-cut" method is generally combined with the stroke method; that is, the wheel is fed in at one end to within 0.001 or 0.002 inch of the finished size, traversed once by hand the entire length of the piston, and then automatically traversed until the diameter is correct. Usually only one automatic traverse is needed, although in some cases several complete passes may be necessary.

Wheels Used for Piston Grinding

When the "draw-in-cut" method is used, the corner of the wheel removes practically all of the stock, and must therefore wear very slowly. This makes it necessary to use harder wheels than when the stroke method is used for the complete operation, as in the latter case the feed for each traverse is only 0.001 or 0.002 inch. Silicon carbide wheels of medium grade are in use in shops where the "draw-in-cut" method is followed, while in the case of the stroke method, wheels in the soft range are more common.

In many plants, roughing is done on one machine and finishing on another, two different grains and grades of wheels being used. In other plants, the piston is ground to the finish desired in one operation, in which case the corner of a hard wheel does the cutting, and the remainder of the face, being glazed, burnishes the surface of the work. The production is often as high as one piston per minute.

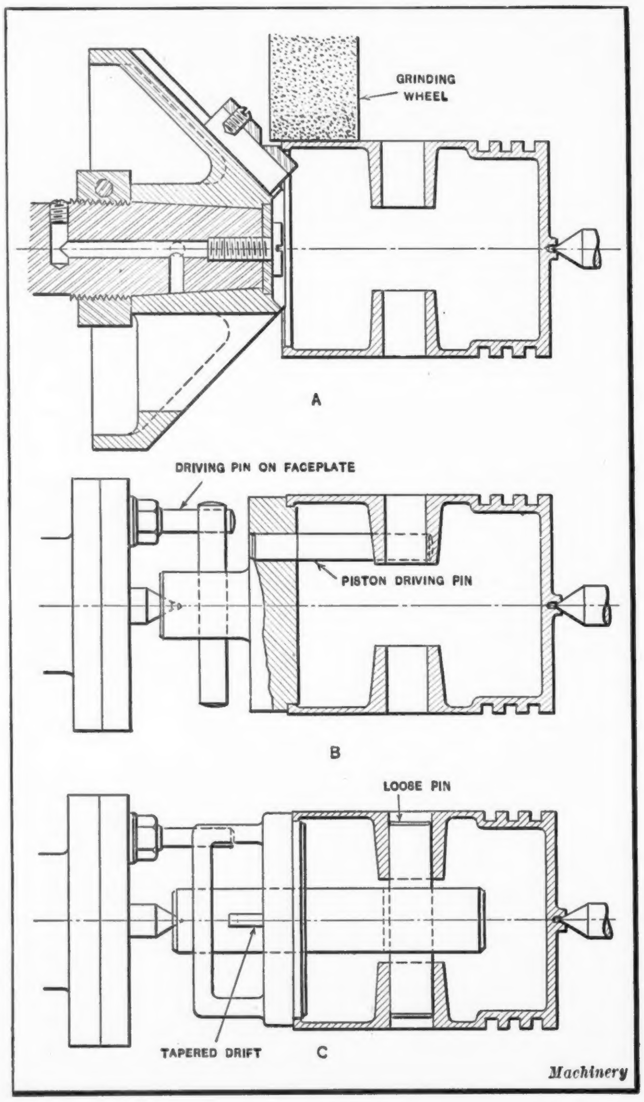


Fig. 2. Three Types of Fixtures or Arbors for holding Pistons while grinding

More care must be exercised when grinding aluminum than when grinding cast-iron pistons. Both aluminous and silicon carbide abrasive wheels are used for this work.

[Note: The silicon carbide abrasives represented by crystolon, carborundum, etc., differ materially from the aluminous abrasives such as alundum, aloxite, etc. The grains of the former are harder but are also more brittle due to the structure; the grains of the latter, while not as hard, are tougher and do not break apart as easily, thus being able to withstand a greater stress. In addition, the aluminous abrasives admit of a certain range of toughness in their manufacture. On account of the difference in physical characteristics of the two abrasives, a general rule has been established, namely, that aluminous abrasives are used for grinding materials of high tensile strength, and silicon carbide abrasives for those of lower tensile strength. While tensile strength alone is not the criterion, inasmuch as hardness and ductility influence the selection, experience has shown that, in general, the aluminous abrasives are particularly adapted for grinding materials of high tensile strength.]

It is very difficult to grind aluminum without producing scratches, unless the operator is very expert, because either a loaded wheel, or abrasive particles coming between the wheel and the piston result in objectionable scratches. The first difficulty is reduced to a minimum, or even obviated entirely, by using a wheel which breaks down easily, as, for instance, an aluminous abrasive elastic wheel, or by treating the wheel face in such a way that the metal particles cannot be forced into the voids between the grains. In the latter case, if silicon carbide vitrified wheels are used, beeswax or paraffin is often rubbed into the wheel face, which, in addition to reducing the loading tendency, helps to give the polished finish commonly desired. High work speeds and frequent truing with a diamond are helpful in reducing the loading.

To prevent the abrasive particles from flowing between the wheel and the piston, the tank should be kept clean and the lubricant renewed frequently. Often a fine-mesh cloth screen is attached to the tank end of the lubricant pipe. The common lubricants used on other grinding work do not give the best results on aluminum. Kerosene or a mixture of kerosene and lard oil are most commonly used.

In addition to the periphery, two other parts of the piston (whether made of cast iron or aluminum) are sometimes ground, namely, the relief around the pin-hole and also the top. For grinding around the pin-hole, the piston is held off center in a cylindrical grinding machine and the relief ground with a narrow wheel. Some manufacturers finish the top of the piston very carefully, because of the belief that any irregularity tends to facilitate the deposit of carbon. This work may be done (1) on a Blanchard type of grinding machine, (2) on a rotary surface grinding machine of the Heald type, or (3) on a disk grinding machine equipped with abrasive disks mounted on metal plates.

Piston-ring Grinding

Piston-rings are finished almost entirely by grinding. Castings are made either singly or in cylinder form, the latter being cast by the "pot" method. When single cast rings are used, the rough rings, as they come from the foundry, must be snagged in order to remove the sprues and fins. Silicon carbide wheels are preferable for this work. Following this operation the rings are either rough-ground cylindrically, being held in a fixture and rotated against the grinding wheel by hand, or are rough-turned. They are

then rough-surfaced in any one of several different ways, the most common method being to use a rotary type of surface grinding machine. Abrasive disks and cylinder wheels are also used for this work in a few plants, the latter method being the more commonly used of the two.

A special type of machine for surface-grinding piston-rings has two cylinder wheels mounted with their faces close together, the distance between them being equal to the desired thickness of the rough-ground ring. The rings are held in a suitable fixture and pushed between the two wheels. Usually about 0.003 inch of stock is left on the ring for the finish-grinding operation. Production of the common types of rings is about 200 rings per hour on this machine.

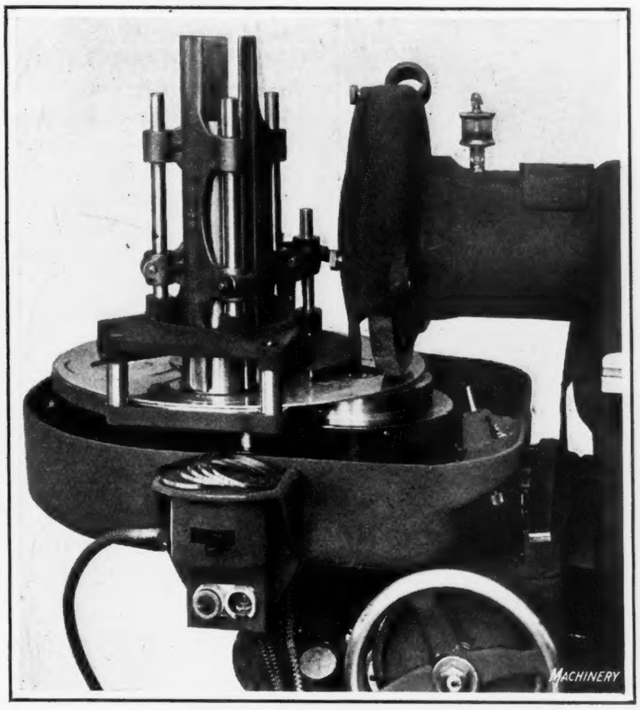


Fig. 3. Automatic Ring-grinding Machine

The finish surface grinding is always done on a rotary type of machine. This is one of the few grinding operations that can be done automatically. The Heald automatic ring grinding machine, shown in Fig. 3, has a magazine type of ring-feeding attachment, and is fully automatic. A feeding plate or carrier disk transfers the rings from the magazine to the grinding position. This disk has five holes to receive the rings, which may be bushed to take rings up to 5 inches in diameter. When the disk indexes, a ring is transferred from the magazine to the center of the magnetic chuck and then, after being ground, this ring is removed as another one slides around to the grinding position.

Current for the chuck is supplied through a rotating disk having an electrical contact. This disk is so timed with reference to the grinding operation that magnetizing the chuck to hold the ring for grinding, and demagnetizing both chuck and work to permit removal of the ground rings are automatically controlled. The wheel-slide of this machine is operated hydraulically, oil being used. A production of 1000 rings per hour may readily be attained.

Another type of attachment makes the surface grinding machine semi-automatic. In this case it is necessary for the operator to place the rings in the holder with one hand, and to remove the ground rings with the other hand, using a non-magnetic hook.

An interesting point in connection with the surfacing of piston-rings on the rotary type of surface grinding machine is the fact that aluminous instead of silicon carbide abrasive wheels are used. This practice is contrary to the general rule that materials of low tensile strength are best ground by silicon carbide wheels, and is probably followed because of the dressing action of the sharp corners of the rings, which makes it necessary to use a tougher abrasive in order to prevent excessive wheel wear.

After the surfacing operation, the rings are split and compressed to the required size, mounted in "gangs" on a special arbor and ground in a plain cylindrical grinding machine. This is merely an ordinary cylindrical grinding operation. Single cast rings are also ground internally, in some cases on a precision machine, but more frequently they are ground "off-hand," as it is not necessary to have the inside dimensions exact.

When rings are cast by the pot method, the castings are trued, bored, and then cut off into individual rings. As their thickness can be brought to size very accurately, only about 0.005 inch of stock being left for grinding, it is not necessary to rough surface-grind the rings. In this way one of the grinding operations which is necessary on single cast rings is eliminated. The other operations performed on rings that are cast by the pot method are exactly the same as in the manufacture of the single cast rings.

Fig. 4. Surface-grinding Operation on Cylinder Castings

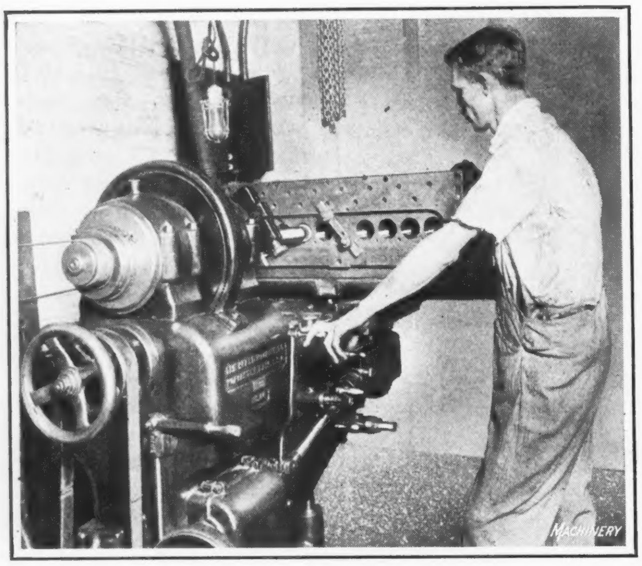


Fig. 5. Grinding Cylinder Bores

Piston-pins are plain cylindrical parts, but in spite of this, they are very difficult to manufacture. This is due to the fact that the pins are hollow, the walls being only about 1/8 inch thick, and also to the fact that in their manufacture they are usually held to the very close limit of from 0.0005 to 0.0002 inch. On this account great care must be exercised in order to produce perfectly cylindrical and uniformly hardened pins. The pins are formed on automatic screw machines, and after heat-treatment are ready for grinding.

Piston-pin Grinding on Cylindrical and Centerless Grinders

The grinding method used, whether it employs a narrow wheel with provision for traverse or a wheel slightly wider than the piston-pin, depends upon the practice of the individual shop. Two distinctly different types of cylindrical grinding machines are used. The older type is the plain cylindrical machine, in which the pins are mounted on arbors and ground like any cylindrical part of similar dimensions. If a wide wheel is used it is fed straight in, there being no traverse except for a slight hand movement of the table when the pin is ground nearly to the finished size. This slight traverse merely brings about somewhat of a dressing action, which helps to keep the wheel face straight. Grinding is done wet, and aluminous abrasive wheels are used which are usually of grain No. 36 combination or No. 46.

The newer type of machine used for this work is known as the "centerless" grinding machine. In the latest types of these machines, the work is held between the grinding wheel, a drive wheel, which is also an abrasive wheel, and a work shoe. The pieces to be ground are fed in at one side of the machine and the drive wheel, which is set at an angle, pulls the work past the grinding wheel. The greater the angle between the axis of the drive wheel spindle and that of the grinding wheel spindle, the faster the work travels. Grinding is done wet, and aluminous abrasive wheels are used. They must be finer than those used on the plain cylindrical grinding machine, and are usually of grain No. 46 or 60 for roughing and of grain No. 80 to 120 for finishing. With the first centerless machines it was difficult to produce round pins, but marked improvement has been made, although the quality is still inferior to that of pins ground on centers.

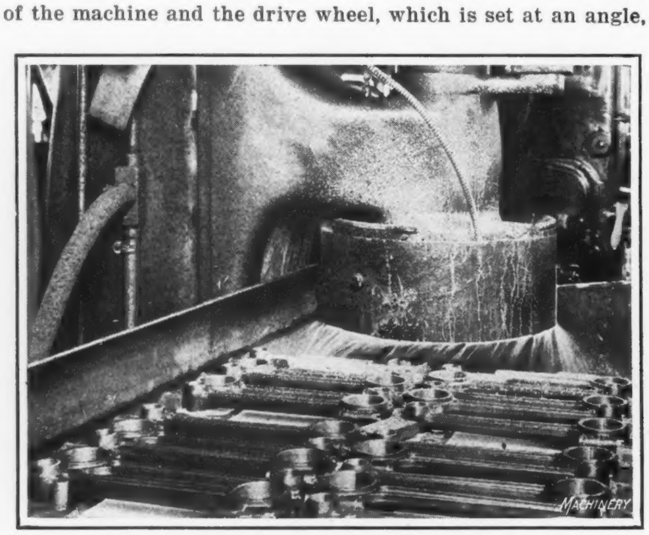


Fig. 6. Grinding the Side Faces of Connecting-rods

Surfacing Cylinder Castings

Cylinder castings are made of either cast iron or semi-steel. The larger number at present are made of semi-steel, which consists of about 20 per cent steel scrap added to the cast iron. This metal must be considered of low tensile strength, and it is most efficiently ground with silicon carbide wheels, the same as cast iron. The important result of adding the steel scrap is to refine the iron and make it finer grained, rather than to increase the tensile strength to a point where it would approach that of soft steel.

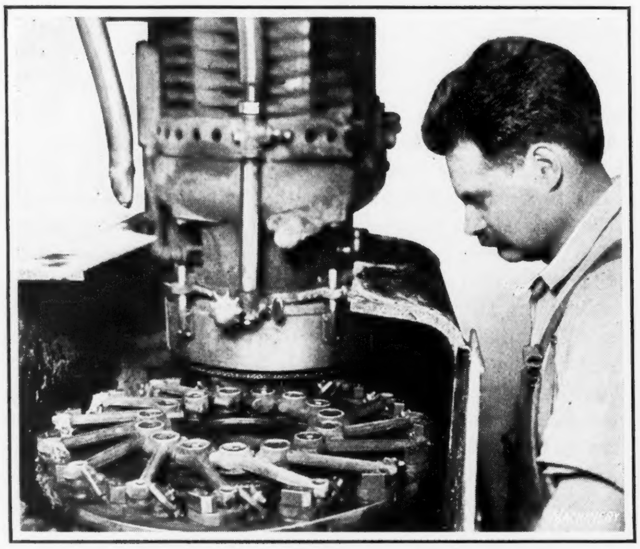


Fig. 7. Another Method of grinding the Side Faces of Connecting-rods

Cylinder castings are surfaced-ground, on a machine of the Blanchard, Pratt & Whitney, or Diamond type, for the purpose of making a commercially perfect joint with the crankcase and also (if the casting is of the open-head type) with the cylinder head. Fig. 4 shows Blanchard machines surface-grinding cylinder castings. The production secured by this operation, because of the rapid removal of stock, compares favorably with the results obtained by milling. The use of water in the grinding makes it possible to maintain high production.

Grinding Cylinder Bores

Before the development of the gasoline engine, cylinders such as are used in pumps and steam engines were usually machined by boring with a single-point tool, there being a sufficient amount of metal in the cylinder wall to resist the pressure exerted by the tool. The gasoline engine cylinder has such thin walls, however, that this method of boring would not give satisfactory results, because the walls would spring and the tool would slide over hard spots in the casting and gouge into soft spots, leaving an irregular surface. Grinding provides an accurate method of finishing cylinder bores, and most automobile engine cylinders are ground, although some manufacturers prefer reaming. (For a discussion of the two methods, see March, 1919, MACHINERY, page 615.) The eccentric-spindle type of cylinder grinding machine is used for automotive work.

Fig. 5 shows a Heald machine grinding the bores of an eight-cylinder engine. The grinding wheel is mounted on a

spindle which, in addition to rotating about its own axis, also travels in a circular path concentric with the circumference of the cylinder hole, making it unnecessary to rotate the work. The cylinder casting is mounted on the machine table, which travels parallel with the axis of the grinding wheel spindle.

The holes are first rough-bored, leaving about 0.005 to 0.008 inch for grinding. This material can be removed easily in three complete passes of the work. The first two roughing cuts are made with the highest speed of table traverse and the lowest eccentric speed, and the finishing cut is made with the lowest table speed and highest eccentric speed. The production naturally depends upon the size of the hole and the amount of stock left for grinding. There are cases on record where as many as eighty holes were ground in an eight-hour day on a single grinding machine, the work being done at the rate of six minutes per hole.

Truing Wheel, Removing Chips, and Cooling Work

Before grinding a cylinder, the wheel must be carefully trued, which should always be done with a diamond. The corners should then be touched up with a silicon carbide abrasive stick or wheel stub, as the sharp corners sometimes

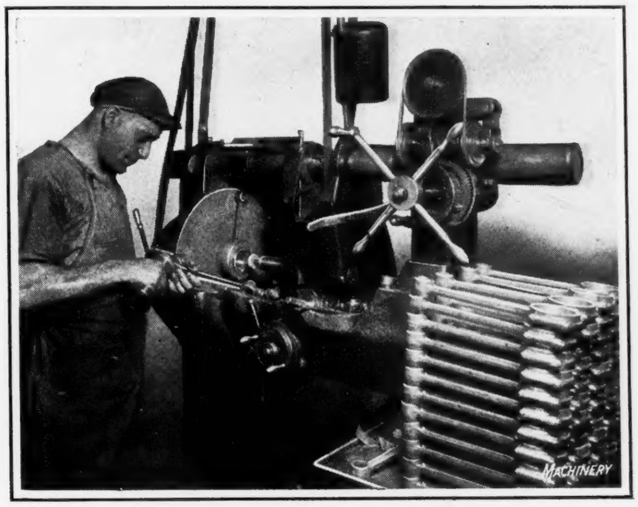


Fig. 8. Internal Grinding Operation on Large End of Connecting-rod

produce feed lines. It is possible in many cases to produce from twenty-five to thirty commercially finished cylinders after each truing, although if a very smooth surface is required, it may be necessary to true the wheel before finish-grinding each hole.

The grinding should always be done dry. Attempts have been made to cool the casting by letting water flow into the hole, but the cast-iron or semi-steel chips and grinding dust that collect at the bottom of the hole form a mud, into which the grinding wheel dips at each revolution of the eccentric. This mud fills up the wheel face and seriously impairs the cutting action. The dust and chips are preferably removed dry by a suction pipe placed at the end of the cylinder hole. This method has practically no cooling effect. A cool cutting wheel is therefore essential, although some of the heat can be carried away by letting water flow over the cylinder or through the water jacket or chambers. In some cases the holes are rough-ground and the casting set aside to cool before the final 0.001 or 0.002 inch of stock is removed. However, this method involves handling the castings twice, and is probably unnecessary, if care is used in cooling the casting as described.

Grinding Compared with Reaming

As a final finishing operation for cylinder holes, grinding is generally considered superior to reaming for the following reasons:

1. A fine finish can be obtained with a grinding wheel much more rapidly than with a reamer. While a good finish

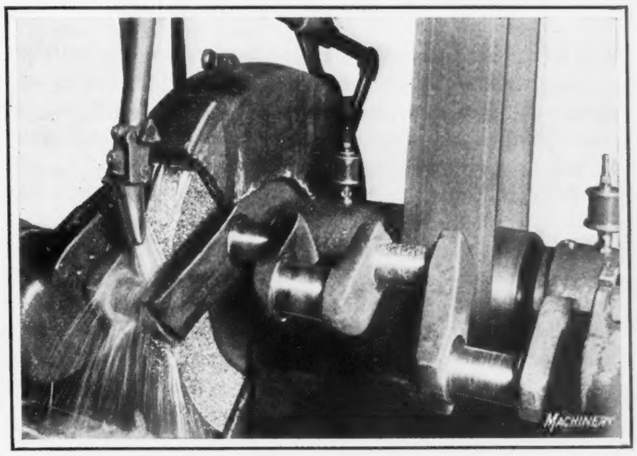


Fig. 9. Grinding Crankpins on a Double-head Type of Machine

may be obtained by taking very light cuts with the reamer, an excessive amount of time is consumed. Much depends, however, upon the reamer and the method of using it, and some automobile manufacturers contend that the finish obtained by a good reamer meets practical requirements, although most cylinders are ground, especially for cars of the better grade.

2. The hard and soft spots that frequently occur in a cylinder casting make it very difficult, and almost impossible in fact, to obtain an even, round hole with a steel tool. A grinding wheel grinds this hard material just as well as the soft sections.

3. There is a tendency for a steel tool to follow more or less the path of least resistance. If, therefore, the hole is not cored straight in the casting, it quite frequently happens that the bored and reamed hole is not at right angles to the crank end.

Grinding Operations on Connecting-rods

The grinding operations on connecting-rods are snagging, surface grinding, and internal grinding. The first operation is not of special interest; it consists merely of removing the stock rapidly by the use of a coarse, hard wheel. The bearing cap and connecting-rod, where they fit together, may be ground to a plane surface and accurate fit by the rim of a small cup-wheel. The side faces of the rods are surface-ground on a Pratt & Whitney or Blanchard type of vertical-spindle surface grinding machine, fifteen or twenty rods being mounted on the chuck of the machine and ground at one time, as shown in Figs. 6 and 7. The bearing cap is then put in place and the small and large holes are ground internally on machines of the Bryant or Heald type, after a rough-machining operation. A Bryant grinding machine is illustrated in Fig. 8, set up for grinding the large ends of the connecting-rods.

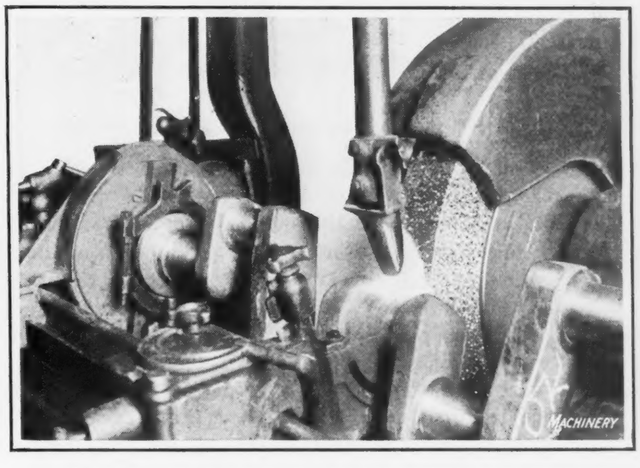


Fig. 10. Grinding Main Bearings of Crankshaft on Plain Cylindrical Machine

Grinding Crankshafts

A typical outline of the operations performed in grinding an automobile crankshaft is as follows: (1) Center the forging; (2) straighten; (3) rough-grind the bearings; (4) turn the flanges and ends; (5) restraighten; (6) rough-grind the pins (sometimes they are rough-turned instead); (7) finish-grind the pins; (8) finish-grind the bearings and outside diameter of the flanges.

Two classes of machines are used—the double-head crankpin grinding machine, Fig. 9, and the ordinary cylindrical machines, in which the crankshaft is mounted in end-blocks or "throw-blocks," which bring the pins successively into alignment with the headstock and footstock centers. In both cases the wheels are as wide as the pins, and the corners are trued radially in order to form fillets. Wheels slightly over size in thickness are furnished to the operator to allow for truing to the exact width required.

When production warrants the use of more than one machine, it is customary to set up batteries of machines, each performing a single operation. A plain cylindrical grinding machine, equipped with special steadyrests and perhaps a wider wheel than is standard for that size of machine grinds the main bearings, as shown in Fig. 10. A double-head pin-grinding machine grinds the first and fourth pins of a four-throw crankshaft, and another double-head machine grinds the second and third pins. Similarly three machines are used for grinding the pins of a six-throw crankshaft.

A cylindrical grinding machine, which is to be used solely for crankshaft work, is ordinarily equipped with a two-speed hand traverse for convenience in truing the wheel and in locating the work rapidly in position for grinding. Steadyrests of ample width are most essential, and in no

Fig. 11. Grinding Cams to the Correct Contour after hardening

class of grinding is the manipulation of the rest more important or capable of greater influence on the quality of work produced. The general principles of cylindrical grinding apply to crankshaft work. For roughing, aluminous abrasive wheels of grain No. 30 or 36 and of hard grade are used. For finishing, aluminous abrasive wheels of medium grade and finer grain give the best results.

Cam Grinding

Cams are usually rough-ground from the black forging, and considerable material must be removed at a very rapid rate. This is practically a semi-precision snagging operation, and it is accomplished by the use of hard, coarse wheels. After the rough-grinding operation, the cams are hardened. In some shops two grinding wheels are used after hardening, one for semi-finishing and the other for final finishing. In most cases, however, the two operations are performed with the same wheel. Either vitrified or elastic wheels are used.

Cam grinding calls for a high grade of workmanship and great accuracy, as compared with other grinding operations in automobile manufacture. The machine must be operated by a careful workman, who knows thoroughly the art of grinding and applies that knowledge continually. The cam-

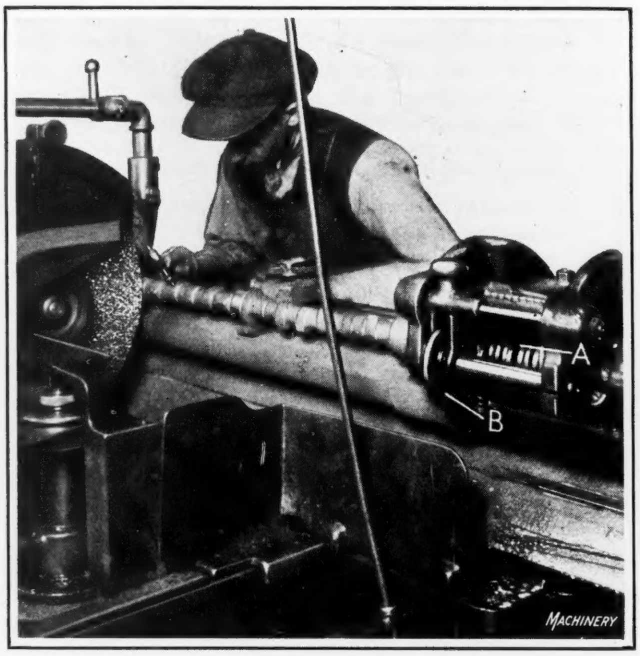


Fig. 12. Rear View of Grinding Machine showing Mechanism which controls the Cam-grinding Operation

shaft is revolved at a constant rate, and the proper shape of the cam is developed by a swinging frame controlled by a cam roller following a master cam. The result of this motion is that the camshaft moves toward and away from the grinding wheel, depending on the part of the cam that is being ground.

Front and rear views of machines arranged for cam grinding are shown in Figs. 11 and 12. The master cams are located at *A*, Fig. 12, there being one master cam for each cam on the shaft. Cam roller *B* is mounted on a fixed shaft and is set opposite first one master cam and then another. The master cams and the camshaft are carried by a member that is free to oscillate; consequently when a master cam is in contact with roller *B*, the camshaft not only rotates but also moves in and out relative to the grinding wheel, so that cams of the required shape are ground.

This operation calls for much attention on the operator's part on account of the irregular shape of the cam. Although the camshaft is rotated at a constant number of revolutions per minute, the peripheral speed and the nature of the contact varies from one part of the cam to another. On this account it is necessary to adapt the wheel to constantly changing conditions. The operator must be especially careful of the finish, which is closely linked up with the surface speed of the work. Careful truing of the wheel with a diamond, in order to make it cylindrical and to make the wheel face smooth, is essential if perfect work is to be produced.

Effect of Wheel Wear on Accuracy of Cams

The effect of wheel wear on the accuracy of the cam being ground is a peculiarity met with in cam grinding. An error will always exist, regardless of the type of machine or the attachment being used, whenever the periphery of the wheel is used in the grinding operation. This error

can be reduced to a minimum, but cannot be entirely eliminated, by regulating the swing of the attachment, so that it approaches more nearly the straight line which passes through the center of the camshaft and the center of the wheel.

If a wheel could be made that would not wear away as a result of the grinding action, there would be no change in the product of such a wheel, provided the diameter of the wheel were exactly the same as that of the one used in generating the master cams. It is not possible to make such a wheel, however, and the slightest amount worn from

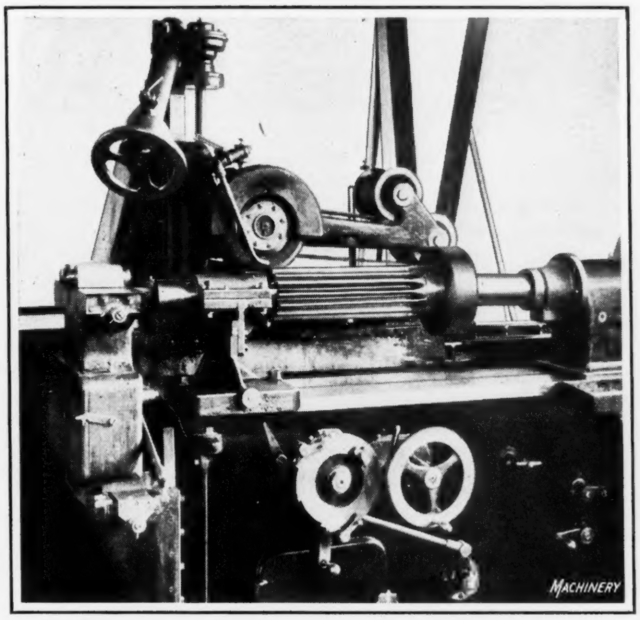


Fig. 13. Gear-tooth Grinding Machine of the Formed-wheel Type

the true theoretical diameter produces a corresponding change in the work. In normal cases with average requirements, the effect of wheel wear does not become evident until one inch or more is worn from the diameter of the wheel, and in many cases the wheel can be reduced as much as four inches in diameter, before the error in the cam becomes so great that it will not pass the inspection limits. The foregoing applies to finish-grinding only. When roughing, this error is just as noticeable but is not considered, as finish-grinding is depended upon to correct the error introduced in roughing. For finishing, therefore, a wheel of the proper diameter should always be used, and it should not be allowed to wear to such an extent that the accuracy of the cams will not be within the established limits.

The reason for this peculiarity of cam grinding is obvious. In common types of cam-grinding attachments, the work oscillates in front of the grinding wheel and also revolves about a fixed center. The center holes are concentric with the heel of the cam, while points along the contour and on the toe of the cam are farther away from the center than points on the heel. As the camshaft revolves, the heel of the cam comes in contact with the wheel at a point on the horizontal line drawn from the center of the wheel to the center of the camshaft. Each point on the side of the cam, however, comes in contact with the wheel at a certain distance below this line, and continues in contact with the wheel until it reaches a point the same distance above the line.

It is evident, therefore, that this is quite different from the grinding of cylindrical work, where each point on the periphery of the work revolves at a uniform speed, and immediately recedes from the grinding wheel after having passed the point of contact. As the diameter of the wheel changes, each point on the cam comes in contact with the wheel at a different time, as compared with when the wheel is full size, and furthermore, remains in contact for a shorter or a longer period according to whether the wheel is smaller or larger than the proper size. There are two points that must be considered when finish-grinding is done, if accurate cams are to be produced: The wheels must be soft so that they will cut freely under light pressure, and the work speed must be low, about fifteen or twenty revolutions per minute being the proper speed.

Grinding Operations on Valves

There are usually three and sometimes four grinding operations on a tappet valve. The valve stem is ground in the ordinary type of cylindrical machine, and the valve seat is ground in a special machine or by using an attachment. A typical example illustrating the use of an attachment is shown in Fig. 15. The valve is held at the required angle relative to the wheel, and is revolved by the small belt seen in the illustration. The ends of the stems are ground in various ways, either by surface or disk grinding, or on the face of a cup-wheel, simple fixtures being used to hold the stems. The fourth grinding operation is illustrated in Fig. 16, which shows the valve head being ground by the use of a special attachment. This is not typical of all valve manufacture, but is an added operation performed by many makers.

Methods of Grinding Spur Gears

When the sides of gears are surface-ground, the ordinary type of horizontal spindle rotary surface grinding machine is commonly used. The production, as in all grinding operations in the automotive shops, is rapid. The appearance of the ground surface is pleasing to the eye, because all grinding lines are concentric with the periphery of the gear.

The holes in gears are ground internally, and the wheels ordinarily used for the internal grinding of hardened steel

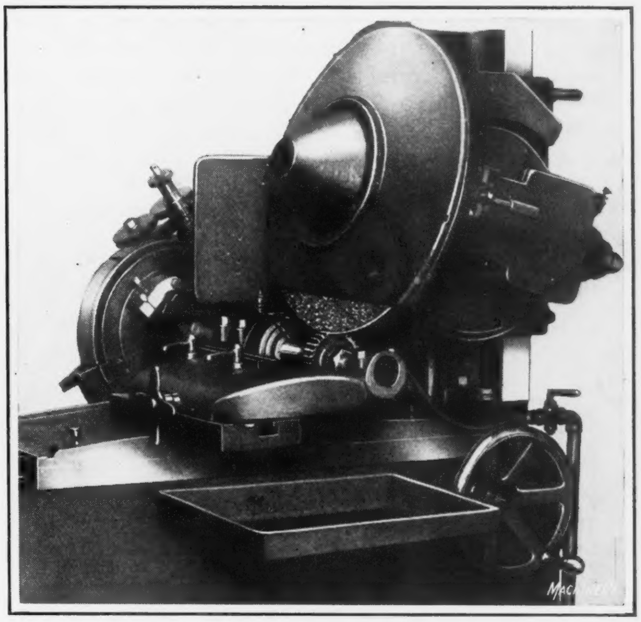


Fig. 14. Gear-tooth Grinding Machine of the Generating Type

give good resuts. If the holes are splined, relatively harder wheels must be used, as otherwise the dressing action of the sharp corners of the spline will cause excessive wheel wear. The larger the number of splines or keyways, the harder the grinding wheel must be to stand up properly.

Gear teeth are sometimes ground to the proper contour after the gears are hardened in order to correct distortions due to heat-treatment, and to obtain accurate tooth forms. This operation requires a special machine. Two general types of machines are used for this purpose, one employing a formed wheel, and the other operating with a generating action. The formed-wheel type of machine, Fig. 13, of the Gear Grinding Machine Co., of Detroit, is so arranged that

the grinding wheel is formed to the shape of the gear tooth by means of a diamond held in a truing device, it being possible to obtain any desired shape, depending upon the master form used. The gears are clamped on the machine table and traversed under the wheel, each tooth being ground singly. The number of gears that can be ground at one time depends on their size.

The gear tooth grinder of the Lees-Bradner Co. is a generating type, so designed that the gear rolls bodily past the wheel to obtain the involute tooth profiles. The grinding wheel (see Fig. 14) is set to the pressure angle of the gear, the straight or flat side which does the grinding representing the side of a rack tooth. The combined sliding and rolling action imparted to the work is obtained from a circular segment in conjunction with steel tapes or bands. The segment corresponds to the pitch diameter of the gear to be ground, and is located on the work-spindle. A diamond mounted on a ball socket container, which can be swiveled to any angle, is used to true the face of the grinding wheel. This machine may be used for grinding involute spur gears having pressure angles varying from 14½ to 24 degrees.

Grinding Worm-gears and Spline Shafts

Although there are several grinding operations in making the rear axle (drive shaft, housing, and differential), the grinding of the worm-gears is the only one of special interest. One type of machine used is made by the Reed-Prentice Co. The grinding wheel is mounted at an angle which is governed by the helix angle of the worm thread, and the travel of the work-table is controlled by a cam in the base of the machine. The cam used must correspond with the lead of the worm, the machine being intended for plants where large numbers of duplicate worms are ground. Another cam controls the cross action of the wheel-head for relieving the wheel during the return stroke and advancing it to the cutting position for the grinding stroke. An index device permits the grinding of single- or multiple-thread worms. A formed wheel is used in conjunction with a wheel-forming device. The wheels employed are about the same grade as those used for spline grinding, but the grain size is a little coarser—generally not finer than No. 36.

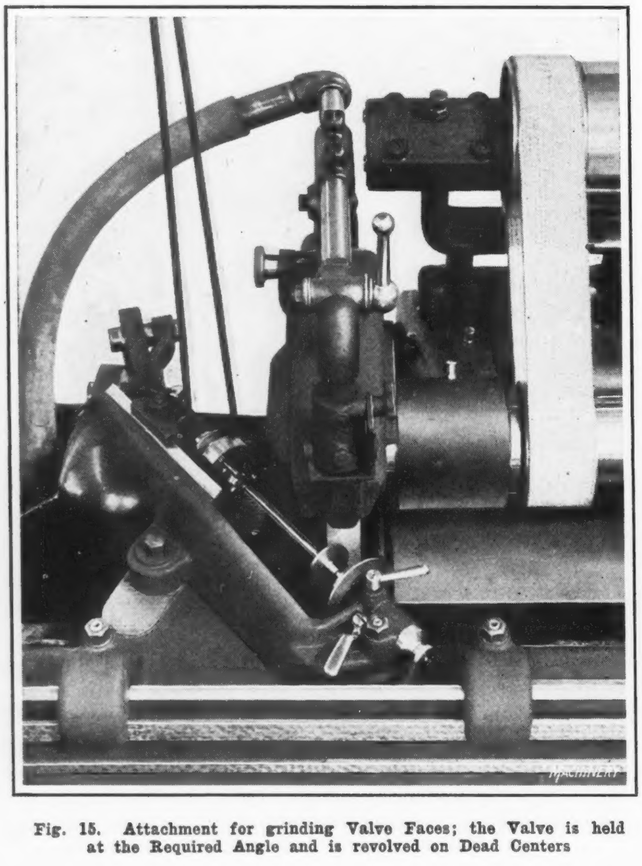


Fig. 15. Attachment for grinding Valve Faces; the Valve is held at the Required Angle and is revolved on Dead Centers

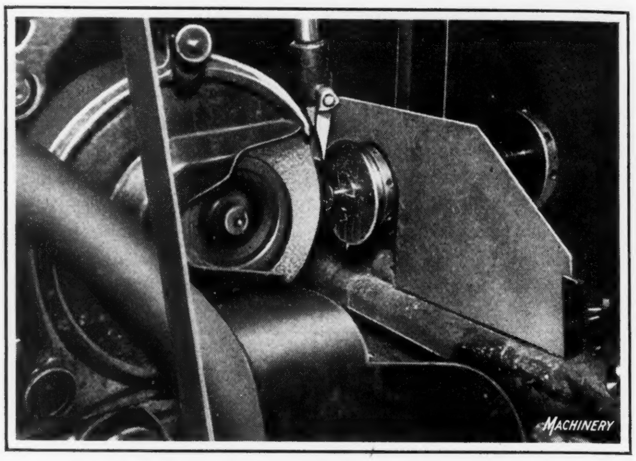


Fig. 16. One Method of grinding Top Surfaces of Valves

The cylindrical grinding operation on spline shafts is no different from that on any of the common pieces ground on a plain cylindrical grinding machine, except that the wheels may have to be somewhat harder to withstand the dressing action caused by the splines. Grinding the splines is a form-grinding operation, the face of the grinding wheel being formed to the correct contour. The multiple-key shaft grinding machine of the Universal Grinding Machine Co. is the type commonly used. The shaft is held in an index work-head, the number of divisions on the dial being determined by the number of keys on the shaft to be ground.

The grinding wheel is formed by two diamonds, one of which forms the periphery and the other the sides. The truing device must necessarily be very accurate. The spline is ground by traversing the shaft back and forth under the wheel, the operation being in reality form surface grinding. The wheel is in contact with the whole contour of the groove between two splines during the grinding, and the corners of the wheel must hold their shape. This operation requires a medium grade aluminous abrasive wheel, the limiting factor being the hardness of the shaft. The grain size is usually about No. 46.

Surface Grinding with Abrasive Disks

Rough surface grinding is finding increased application in the automotive shops, the grinding being done on disk grinders having abrasive disks glued to metal plates. Such parts as pump cases, exhaust connections, gear-cases and covers, cylinder heads, and crankcases are ground in this way. There are two types of machines used, one having a horizontal and the other a vertical spindle. When grinding on horizontal-spindle machines a special work-holder is often used. The part being ground is traversed across the face of the disk, and at the same time is forced against the disk by a hand-lever. This kind of grinding is done dry.

The vertical-spindle machines carry disks as large as 53 inches in diameter, and the parts to be ground are laid on the revolving wheel. When the weight of the work is equal to three or four pounds per square inch of area to be finished, no external pressure is required; but when it is less, weights are laid on the pieces being ground. An exhaust system is provided to remove the dust, the openings being directly beneath the outer edge of the wheel on which a disk is mounted.

Abrasive disks for heavy work such as this are made of artificial abrasives held on canvas or heavy paper backs by means of glue, shellac, or other materials having similar properties. The exact compositions of the binding materials used by the different concerns manufacturing these disks are the result of constant experimental work and are held as trade secrets. The disks are attached to the metal plates by glue, shellac, silicate of soda or a similar material.

Another article on grinding in the automotive industry will be published in the August number.

COMPETITION IN THE FRENCH MACHINE TOOL TRADE

By W. P. MITCHELL

The French machine tool trade is entering upon a stage of very active competition. French manufacturers have made remarkable progress in machine tool development, and are successfully competing, in point of price, with many lines of American and British machines, and in some cases with German machines as well. For special and high-duty machinery, France must still look abroad, as the comparatively small demand in France for machinery of this type would not warrant the French manufacturers entering these fields.

The drop in the value of the mark, as compared with the franc, has caused German manufacturers to increase their catalogue prices in a marked degree, so that many German-made machines are now higher in price than similar machines of French manufacture. This, of course, is partly due to the fact that German machine tools over 2200 pounds in weight pay a duty of 64 francs per 220 pounds, while similar machines from America and England pay a duty of only 16 francs per 220 pounds.

The average lathe or grinder of German manufacture in the French market is selling in Paris at from 20 to 30 per cent less than the American product of similar type, but the French are now making machines that sell for from 20 to 30 per cent less than the German machines. Hence French machine tools are prominent in the market at present, although American milling machines and grinding machines are preferred to any French machines, even though the French prices are from 40 to 50 per cent less.

Prices of Machine Tools in France

It is evident that the adverse exchange rates, the French tariff, and the high freight rates are the main causes for the difference in prices of French and American machines. This has aided French builders to capture a very considerable part of their home market. A few comparative prices of American and French machine tools of similar type may prove of interest. A French turret lathe selling at 9500 francs competes with an American lathe selling in Paris at 12,220 francs. A French 40-inch planer with a 10-foot bed is sold for 25,000 francs, while an American 36-inch planer with the same length of bed costs 40,700 francs. A French 4-foot radial drilling machine sells for 25,000 francs, as compared with 38,900 francs for the American product. In general, these comparative prices are for first-class machines in both cases, but French manufacturers have also placed on the market less expensive grades of machine tools of a type that was formerly imported from Germany. The German machine tools at present are priced higher than the French but lower than the American, as already mentioned.

In the following are given additional prices of French machine tools. American manufacturers may make comparisons for themselves with American prices:

14-inch lathe, medium grade	7500 francs
3½-foot radial drilling machine	15,000 francs
15-inch shaper	5000 francs
25-inch shaper	9500 francs
30-inch planer with 6-foot bed	15,000 francs

Prospects for American Machine Tools

Under present economic conditions in France, it does not seem possible to create a better position for American machine tools. The only opportunity that is now apparent is in the case of high-duty machines or special machines that are not being built in France. But American manufacturers in most lines have ever been specialists, pioneers, and improvers, and this will give them strength in the world's markets in all those countries where progress is the watchword; and if France is to hold her own as an industrial country, she must adopt a progressive policy. If France makes proper use of her ore resources and metal industries, no other European country will be able to surpass her in quantity of output.

There is little opportunity of being able to bring American prices in France down to the French level, because it will be a long time before exchange will return to pre-war figures. The French tariff is also a matter to be considered. Manufacturers in all lines in France are asking for further protection. Another possible item in favor of the French manufacturer is the adoption of more efficient production methods. There is continual progress in this respect, which is chiefly manifest in two or three automobile plants. If the eight-hour day law is repealed and there is generally increased production, prices for machinery manufactured in France may come down still further. The same will be the case if the piece-work system is more highly developed. It is true that all of these possibilities are contrary to French routine and tradition, but it might be said that even in France "the old order changeth." In the future, capital in France will have to be content with a smaller return, and the workman will have to be paid more, or living costs will have to come down. A few people in France see this. That is why there is a general transformation of old-time French business methods, or an attempt to make such changes.

French Industrial Fair

The seventeenth industrial fair recently opened in Paris. During the last three years the number of exhibitors has tripled, the number this year being over 4500. Some of the large concerns like the Creuzot and Saint Chamond steel works occupied their own special buildings. This Paris fair (or "Foire de Paris") is destined to become an important part of French industrial life. The exhibitors are either French or of French affiliation. The various metal industries occupied, perhaps, the most important position.

Small electrical tools, drills, brushes, grinders, and polishing machines are now being made in quantities. This equipment is along the general lines of American products. Further development in the manufacture of these small tools depends upon a more general adoption of electricity, and the manufacture of such specialties in France is still in its infancy. Electrical lifting magnets and other elevating and lifting apparatus are being manufactured in France on an increasing scale which is also true of polishing machines of the belt type. It is noted with respect to this latter specialty, as with many others, that the greatest demand is for small tools and other shop equipment (formerly purchased abroad) which may readily be manufactured in small French plants.

One of the most imposing exhibits of heavy machine tools is that of the H. Ernault Co. The exhibit includes engine and turret lathes of large capacity, one lathe having a swing of nearly five feet. A grinding machine made by this firm and having a range of six feet between centers sells for 28,000 francs (about $2500 at the present exchange rate). The Metallurgic Co. of Persan-Beaumont is exhibiting an engine lathe having a swing of 18 centimeters (about 7 inches) and a maximum distance between centers of 1.30 meters (4 feet 3 inches). The price is approximately $650.)

A "Somua" radial drilling machine, capable of boring a hole 7 centimeters in diameter (2¾ inches) sells for 45,000 francs (approximately $4000) delivered in Paris where it is manufactured. The weight of the machine is 11,500 kilograms (25,300 pounds) which an American authority considers inordinately heavy. Another heavy-duty machine of the same make, capable of boring a hole 8.5 centimeters in diameter (3 11/32 inches) sells for approximately $6000. Electrical and autogenous welding machines of French manufacture are appearing in increasing numbers.

A large demand for electrical machinery and accessories is anticipated, following the rapid development of electrical power generation along the Rhone river and the streams of the French Alps and Pyrenees. The southern French railways are planning for extensive electrification within the next five years, and surplus power will be available for industrial enterprises along the route.

Piston Pump Manufacturing Methods

THE double-acting piston pump made by the Goulds Mfg. Co., Seneca Falls, N. Y., which is known by the trade name "Pyramid," consists of a gear-operated cross-head and piston, the stroke of which must be exactly at right angles to the parallel shafts on which the driving gears and pinions are mounted. The cross-head travels on guide-rods extending from holes *A*, Fig. 1, in the main cylinder casting, and the gear and pinion shafts are carried in bearings *B* and *C*, respectively, which are babbitted. The cylinder casting shown is for the 6- by 12-inch pump—the largest size in this style of pump that is manufactured. The piston travels in the brass-lined cylinder bore *D*, and the cylinder head is fitted to surface *E* and carries the stuffing-box. The pitmans are attached to each side of the cross-head, one connecting with a crankpin on an arm of the gear at one side of the pump, and the other with a similar pin in a crank-plate at head set-screw, so that they may be quickly replaced. The counterbore has a piloted end that enters the cylinder bore, thus insuring concentricity with the counterbored surface.

Assembling Brass Liner in Cylinder Bore

After counterboring, a No. 16 gage brass liner *H*, Fig. 1, is forced into the cylinder bore. This is assembled by means of a pestle-shaped press arbor *A*, Fig. 2, which has a turned shoulder that seats in the end of the tube, and a shank to enter the machine spindle. The liner is forced into position by the spindle handwheel, after which it is anchored in place by setting over the ends of the liner with a hammer. A special tool having three rolls is used to roll the brass liner snugly against the cylinder bore. This tool is carried in the machine spindle and fed by power. The rolls may be adjusted radially by means of a spindle with a tapered nose, which causes the roll-carriers to expand when the adjusting collar is turned. To contract the rolls, for the smaller diameters of liners, the collar is turned in the opposite direction, and the roll-carriers are forced radially inward by means of springs.

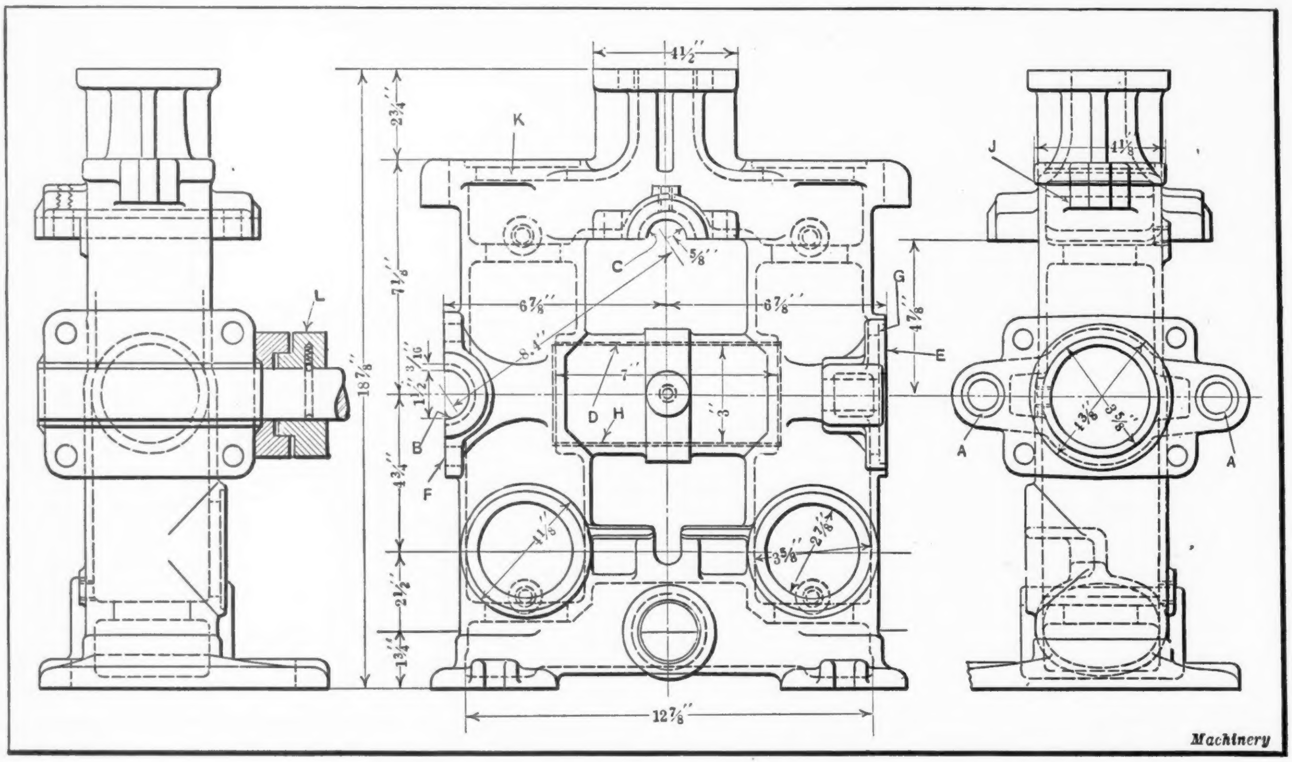


Fig. 1. Detailed Views of Cylinder Casting for Double-acting Pump

the opposite side of the pump. The gear and crank-plate are assembled to opposite ends of the driving shaft.

The operations described are those that are performed to establish an even piston stroke at right angles to the gear and pinion shafts. This condition is of vital importance to the satisfactory operation of the pump. After face-milling the base of the casting on a horizontal milling machine, the work is transferred to the machine shown in Fig. 2. This illustration shows two drilling machine units mounted on a common platen, for convenience in machining the cylinder bore, the counterbored surface for fitting the stuffing-box, the guide-rod holes and the cylinder-head bolt holes.

Boring and Counterboring Operations

The casting is located on a bridge iron fixture on which it rests on four shims placed under each corner of the rough surface *F*, Fig. 1. Inserted-blade boring heads are used to rough- and finish-bore cylinder *D* and to counterbore *G*. The bars on which these heads are carried are driven by a key in the machine spindle, and are fastened by a hollow-

The work is next shifted to the second spindle, where the four bolt holes for the cylinder head and the two guide-rod holes are drilled and reamed, and the guide-rod holes are also counterbored. For this work a jig plate with a cut-out section that straddles the lug *J*, Fig. 1, is employed. The plate is thus located on the casting, and is anchored by a long eyebolt that passes into the casting far enough so that a bar placed in the discharge hole *K* will also pass through the eye of the bolt. As the nut at the plate end of the bolt is tightened, the eyebolt is brought up against this cross-bar and the jig plate secured in place.

Babbitting Fixture

A special fixture is used for babbitting the gear and pinion shaft bearings *B* and *C*, Fig. 1. This fixture is shown in

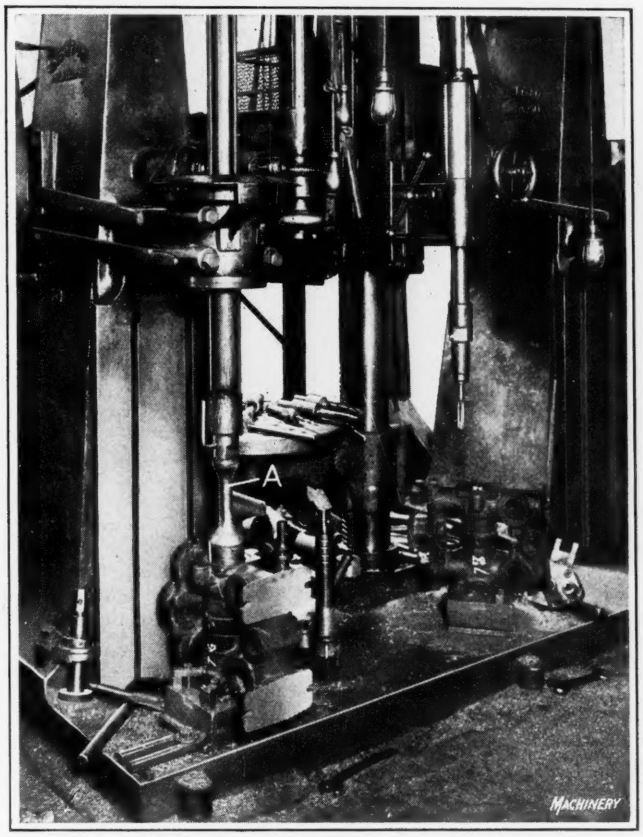


Fig. 2. Drilling Machine on which the Cylinder is bored and the Cylinder Head Bolting Surface machined

place in Fig. 3 with the bearing caps assembled, cardboard packing being used. With this fixture the correct gear center distances are obtained, and the bearings are held parallel with each other and at right angles to the cylinder bore. The side supports of the fixture are T-shaped, and they are attached at the back to a plate by means of which the fixture is fastened to the cylinder-head bolting surface *E*, Fig. 1. It is located by two posts that engage the guide-rod holes at this end of the casting. This plate is shown at *A*, Fig. 3; one of the guide-rod holes used to locate the fixture may also be seen in this illustration.

The side supports or arms have elongated slots by means of which they are bolted to the plate so that they may be placed in the correct position to bring the two arbors central with the cored holes to be babbitted. The center distance of the arbors, which for this size pump is 8.4 inches, is fixed, so that the use of the fixture insures correct relative positions of the gear and pinion shafts. After the caps have been assembled and the fixture has been properly adjusted, the ends of the bearings are closed by special collars. These collars are shown in position on the arbors, and their construction and use is clearly shown in Fig 1 at *L*. There is a pair of collars for each bearing end, one collar of each pair having a spring-snap, which locates it by engagement with a circular groove on the arbor. This collar has a shoulder over which another collar fits so that it may be slid to bear against the end of the bearing. It should be observed that the inner collar is shaped to give the babbitt bearing a built-out surface to receive the hub of the gear or pinion.

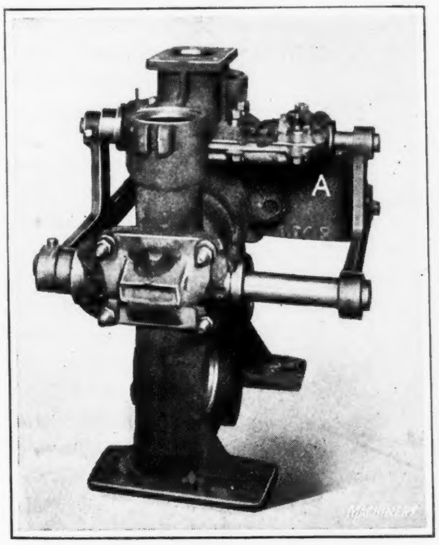


Fig. 3. Babbitting Fixture for Gear and Pinion Shaft Bearings

For luting the joints and for packing in between the slip and loose collars, etc., a composition of ground asbestos and oil is used. This has proved to be more satisfactory as a sealing material than clay, and it is easily prepared and does not harden so as to become unworkable, as is often the case with other luting materials. In the illustration Fig. 3, it will be seen that everything is in readiness for pouring the bearings, including the closing of the joints with the ground asbestos luting material. After the bearings have been poured and the fixture has been removed, no further work is required to obtain the desired relationship of these bearings with the cylinder bore. The amount of machining which is saved, as compared with the use of bronze bearings (when the casting must also be machined) should be readily realized, as well as the accuracy which is obtained.

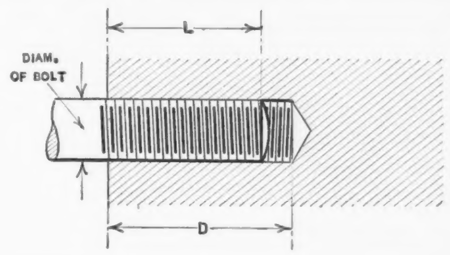
* * *

TAPPED HOLES FOR STUD BOLTS

By A. ERICSEN

There seems to be no established practice or rules for determining the correct depths of tapped holes for stud bolts. To insure satisfactory results, this matter should be given more serious consideration than is usually accorded it by engineers, draftsmen, and shop foremen. The accompanying table was prepared by the writer and gives a factor of safety that has proved satisfactory. This table has been used to advantage in making lay-outs, and has been adopted as standard practice in several engineering departments. It is suitable for use in all machine design work, and can be safely employed for high-pressure fittings with standard threads.

TABLE OF THREAD LENGTHS AND TAPPED HOLE DEPTHS*



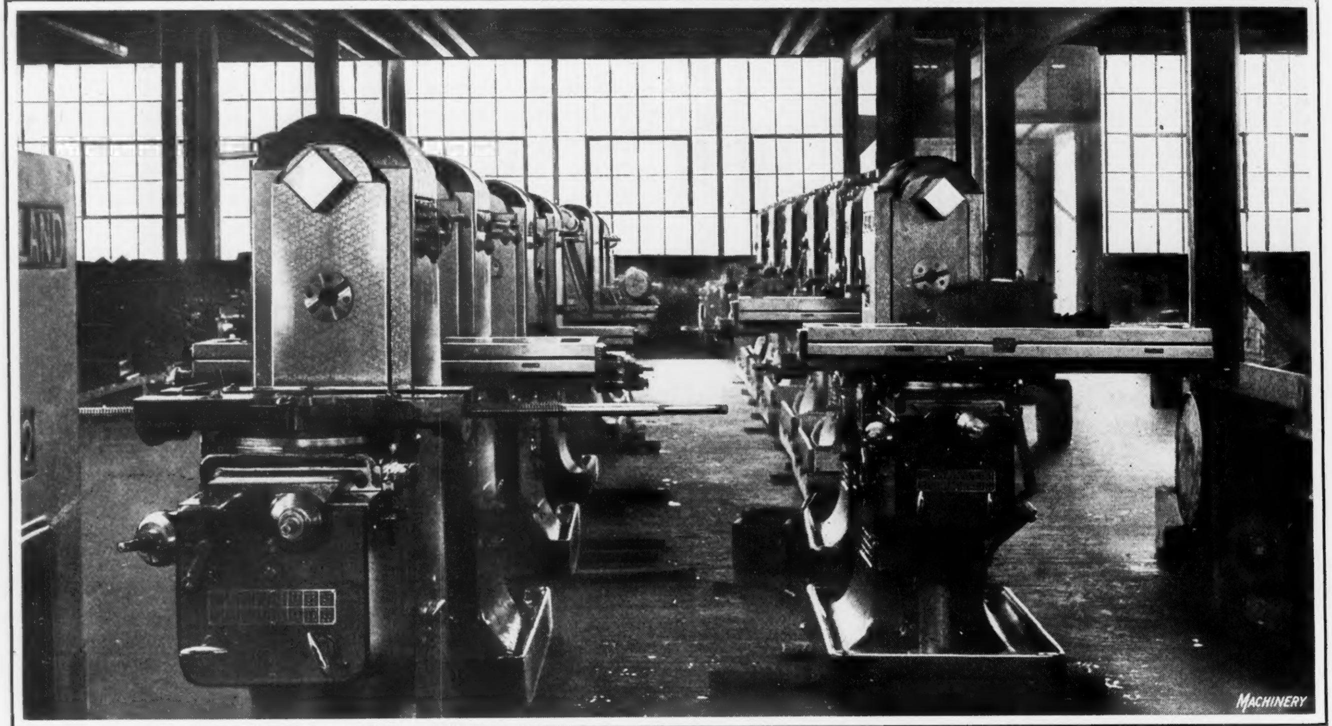
Diameter of Bolt	Cast Steel		Cast Iron		Diameter of Bolt	Cast Steel		Cast Iron	
	L	D	L	D		L	D	L	D
⅛	¼	⅜	¼	⅜	1⅝	2⅛	2⅝	2½	3
¼	⅜	½	⅜	½	1¾	2¼	2¾	2⅝	3⅛
⅜	½	⅝	⅝	¾	1⅞	2⅜	2⅞	2⅞	3⅜
½	⅝	¾	¾	⅞	2	2½	3¼	3	3¾
⅝	⅞	1⅛	1	1¼	2⅛	2¾	3½	3¼	4
¾	1	1¼	1⅛	1⅜	2¼	2⅞	3⅝	3⅜	4⅛
⅞	1⅛	1⅜	1⅜	1⅝	2⅜	3	3¾	3⅝	4⅜
1	1¼	1½	1½	1¾	2½	3⅛	3⅞	3¾	4½
1⅛	1½	2	1¾	2¼	2⅝	3⅜	4⅛	4	4¾
1¼	1⅝	2⅛	1⅞	2⅜	2¾	3½	4¼	4⅛	4⅞
1⅜	1¾	2¼	2⅛	2⅝	2⅞	3⅝	4⅜	4⅜	5⅛
1½	1⅞	2⅜	2¼	2¾	3	3¾	4½	4½	5¼

Machinery

*For wrought iron and cast bronze, use values given for cast steel, and for aluminum and brass, use those given for cast iron.

Broken taps and stripped threads result from incorrectly specified tapped hole depths. For instance, if a ¼-inch stud hole is tapped 1 inch deep or more, it simply means that time is wasted and unnecessary expense involved. When holes for stud bolts are drilled and tapped to a greater depth than necessary, it follows that either a large cavity will be left under the stud bolt, or the threaded part of the bolt will be greater than is required to insure the full holding power.

Aligning and Inspecting Milling Machines



THE methods employed in the final alignment and inspection of the Cleveland milling machine are described in the following. This machine consists of four main castings—the column to which the knee is accurately fitted; the knee, which carries the saddle, scraped and gibbed to a tongue and groove fit; the saddle (either plain or universal), in the scraped groove of which the table has its bearing; and the table. In establishing a working surface for the table that is level and parallel with the horizontal center line of the spindle and over-arm, as well as at right angles to the vertical bearing on the column, each fitted surface must be held within very close limits of accuracy.

The accuracy required in the manufacture, assembly, and inspection of high-grade machine tools is generally appreciated. To attain the necessary degree of accuracy, great care must, of course, be taken in the final assembling and fitting operations. The practice outlined in this article is that adopted by the Clark-Mesker Co., Cleveland, Ohio, in building the Cleveland milling machine. The article deals with the final aligning methods and the inspection of this machine.

Fitting the Column and Knee

The columns of the machines (and in fact, all castings on which considerable machining is performed) are first planed to produce a suitable surface from which to locate the castings in a fixture, in which position they are not only completely planed, but also bored. The bronze bushings for the gear shafts and main spindle bearings are assembled before the columns are delivered to the assembling floor. The first attention that is given to these castings is to inspect thoroughly the oil troughs and passages for the free flow of oil. This is of paramount importance, because the splash oil system is used in this milling machine. The inside walls of the castings are then scoured and cleaned to remove all molding sand, and a coat of binding material, such as shellac, is applied to these surfaces. The knee castings are subjected to practically the same treatment as the column before any fitting of these two units is done.

The machined castings are left lying on the floor to become seasoned, so that when the bearing surfaces are subsequently scraped in, a permanent set of the fitted bearings will be obtained. The columns are blocked up in the manner indicated in Fig. 1, and the long vertical knee tongue bearing scraped to a master jig. The illustration shows one of these jigs in position on a column and another of similar design resting on the wooden horses at the right. In this operation, the top of the tongue is not scraped, because this surface is not a fitting surface, and between it and the knee groove there is a clearance of from 0.003 to 0.005 inch. The groove of this jig is slightly wider than the tongue on the column so that the jig may be pushed over to form a bearing on one side while scraping, and then to the other side.

In order to maintain parallelism of the scraped surfaces on both sides of the tongue, an adjustable gage consisting of two angular blocks is used. This gage is shown lying on the bearing surface of the second column, from which it will be seen that the two blocks may be set as required by the width of the tongue and that the angular and horizontal surfaces of the blocks are parallel. In rubbing down the surfaces to determine whether there are any high spots, a coating of red lead is applied.

The tongue of the knee casting on which the saddle of the machine has its bearing is scraped to a master jig in the manner just described. This tongue may be seen in Fig. 3 at *A*, but this illustration does not show the scraping operation. The knee is next scraped to the column bearing, a special overhanging angle-plate type fixture being employed by this operation. The fixture is attached to the saddle bearing of the knee as indicated in Fig. 2. This angle-type fixture consists of two cast-iron plates *A* and *B*, set at right angles on a grooved bear-

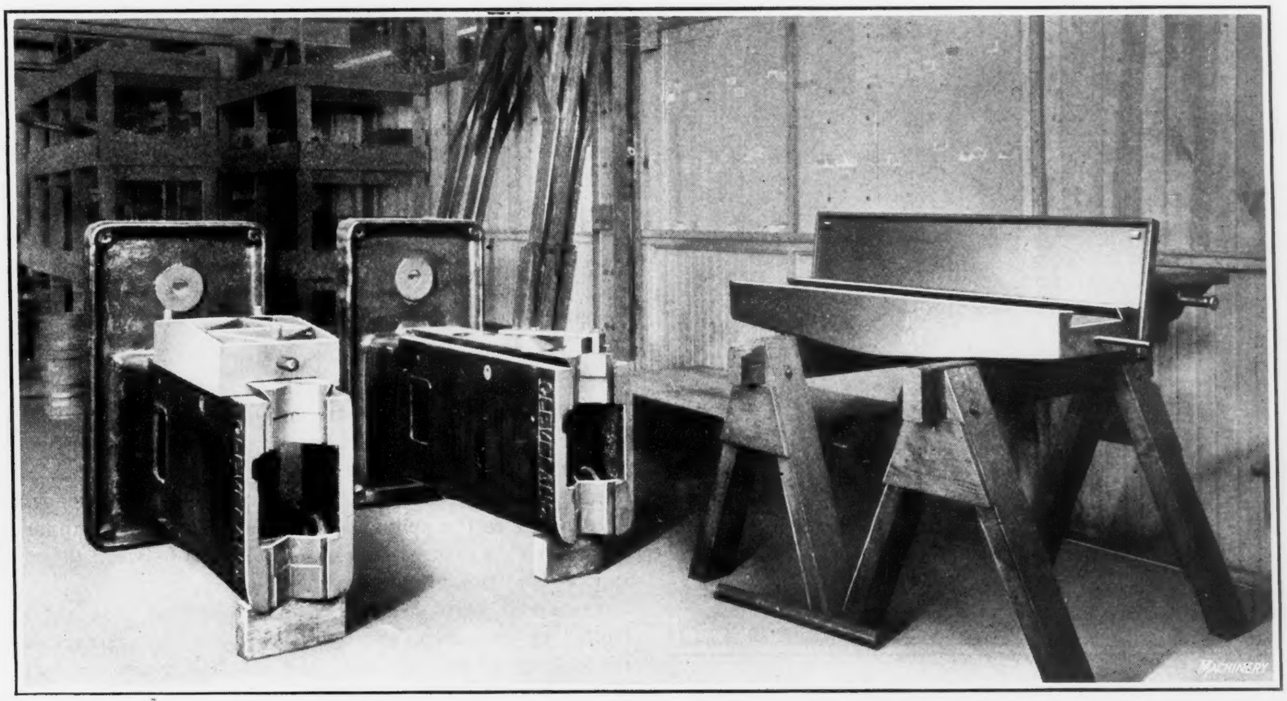


Fig. 1. Milling Machine Columns blocked up in Readiness for Scraping

ing by means of which the fixture is secured to the saddle tongue. It extends twice the ordinary length of the usable part of the column bearing, so that in using an indicator at the extremity of the plates to test the relationship of the saddle bearing and the knee bearing on the column, a greater degree of accuracy can be obtained than if the plates were not thus extended.

In fitting these two castings it is required that the saddle bearing be perpendicular with the column bearing of the knee within a limit of 0.001 inch, and in checking this relationship an angular block carrying a Starrett dial indicator is used. The horizontal plate *B* of the angle fixture has its vertical side accurately scraped and adjusted to be parallel with the tongue on the column. The vertical plate *A* has it's under side made parallel with the flat bearing surface of the column. In using the indicator, these surfaces are employed to check the alignment at one side of the column only, as shown in the illustration. When the desired condition has been obtained, a taper gib is fitted between the column tongue and knee groove at the opposite side. If this operation in carefully done and the knee is kept bearing against the tongue of the column at one side, the gib may be fitted with the assurance that the required limit between the saddle bearing on the knee and the column bearing is obtained. The close limits specified in fitting the knee to the column are of vital importance to the perfect alignment of all parts supported on the knee with the machine spindle.

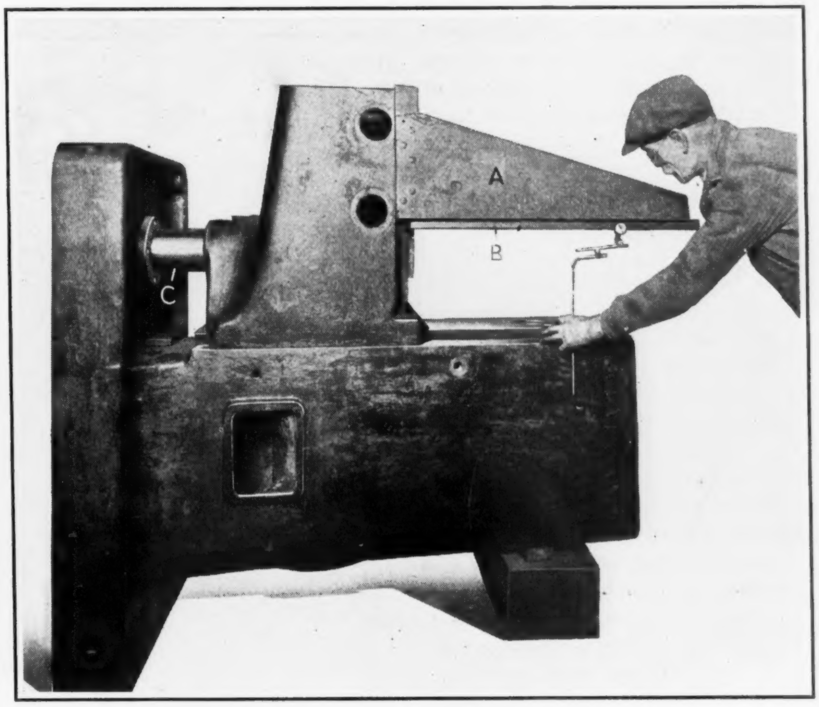


Fig. 2. Fixture for inspecting Assembled Column and Knee

The final operation in fitting the knee is scraping the under side of the flange on the knee guide post *C*, to form an even bearing on the faced boss in the base of the column to which this flange is bolted. This also is an important operation, because the elevating screw for the knee passes through a nut assembled in this post, and it is vital that no cramming of this elevating screw occur. The guide post is then bolted in place.

Fitting the Spindle and Over-arm Bearings

With the column set upright, the spindle bearings and over-arm bearings in the column are aligned relative to the saddle bearings of the knee. The method of testing the relationship of these bearings is illustrated in Fig. 3. The spindle of the machine runs in taper bearings, one at the front and one at the rear of the column. These bearings are scraped to alignment and parallel with the knee, Prussian blue being used in this operation to detect the high spots. A long test bar is then placed in the spindle bearings and a sliding block and dial indicator are used in the manner illustrated, on the left-hand side of the tongue. The allowable limit of parallelism between the spindle bearings and the knee bearings is 0.001 inch.

The planed V-bearings in which the square-section over-arm of the machine is fitted are then scraped to parallelism with the spindle bearings. The equipment used for testing the accuracy of these operations is also illustrated in Fig. 3. The over-arm is

Fig. 3. Test Bar and Indicators used in testing the Spindle Bearings and the Over-arm Bearings in Relation to the Knee Bearings

placed in position and on its top surface an angular slide is seated to which the indicator arm is attached. The same limit of accuracy is maintained on this operation as is required in assembling the spindle bearings, that is, 0.001 inch. It will be understood that this angular slide is moved back and forth on the over-arm with the indicator point in contact with the test bar, before the over-arm cap is assembled. Assembling the cap is the next operation, the only requirement in this case being that the over-arm shall slide freely.

Fitting the Saddle and Table

The machine may be equipped either with a plain or a universal table. In scraping the saddle of the plain milling machine, the top and bottom surfaces are scraped parallel on the bench, a Brown & Sharpe surface plate and red lead being used. The table is next scraped to its bearings in the saddle, an adjustable gage of the type illustrated in Fig. 1 being used to maintain parallelism, and the taper gib is then fitted in place. This work is all performed on the bench.

The left-hand side of the tongue and groove by which the saddle and knee are fitted, is then scraped to a bearing and the tapered gib *A*, Fig. 4, fitted on the right-hand side as shown. In inspecting the accuracy of the fitted bearing of the saddle and knee, the long table furnishes a surface from which the spindle bearings are tested. The gib has been temporarily fitted only, so that in squaring up the table and saddle with the spindle bearings, the saddle may be readily removed as required to correct any inaccuracies that may have been detected in this test.

A long sweep or arm on the test bar in the spindle carries the indicator which is swung from one end to the other of the table, the indicator bearing on the rear vertical planed surface. The table is 50 inches long, and the parallelism between the knee bearings for the saddle and the spindle is thus inspected and held to a limit of 0.002 inch in a length of 50 inches. Since the table surface is planed at the same setting as the saddle bearing surfaces underneath the table, it is possible to use this surface to indicate from without danger of errors due to inaccuracies in machining.

It may be interesting to note that the table castings are seasoned in the open for several months before being machined. They are then rough-planed all over and allowed to set in this semi-finished condition until it is necessary to finish up a quantity to fill an order. As the thoroughly seasoned castings have several surfaces machined at one time by the use of multiple tools, set to a master gage so that the relation between all the surfaces is kept uniform, a high degree of accuracy is obtained.

When the milling machine is to be equipped with a universal saddle (see the heading illustration) in which the table rotates on a swivel, the swivel is first graduated and the zero graduation marked on the universal saddle after the assembled saddle and table have been first set square with the spindle bearings. In setting the saddle and table of a universal milling machine, equipment similar to that illustrated in Fig. 4 is employed, which was described in connection with the scraping-in of the saddle bearings for a plain machine.

Boring Over-arm Pendants—Gear Testing

The over-arm pendant, which supports the cutter-arbor, is bored for the outboard support of the arbor with the set-up illustrated in Fig. 5. The boring-bar *A* is of the fly-cutter type, and is carried in the regular spindle bearings. The over-arm is fed to the cutter by a hand-operated device which is attached to the column of the machine in the manner indicated. This assures absolute parallelism between the arbor support and the spindle bearing.

The speed gears, which are of the sliding type and controlled by an automobile shift lever handle, are carried in the column of the machine, and the feed gears are located in a box at the front of the knee. Both sets are inspected for backlash and running qualities by means of a master gage which is a replica of the gears used in the particular train being tested. The gage illustrated in Fig. 6 is for testing the speed gears. It is used by simply placing the various gears on their respective shafts, which rest in open bearings on the master gage, and revolving them by hand. By this simple but effective means the action of the entire gear train can be clearly observed.

Running-in Test and Final Inspection

After the machine has been completely assembled and is ready for operation, it is given a running-in test at all speeds without load. During this trial run the inspector is required to make observations of every part of the machine that it is possible for him to inspect, and enter a notation opposite every question on a special report sheet. For example, in inspecting the column he must report, among other things, on the following items: Supply of oil in the column; adjustment of starting friction clutch; operation of gear-shifting bars by means of the ball lever, sockets, etc.; operation of the speed reverse mechanism; alignment of the

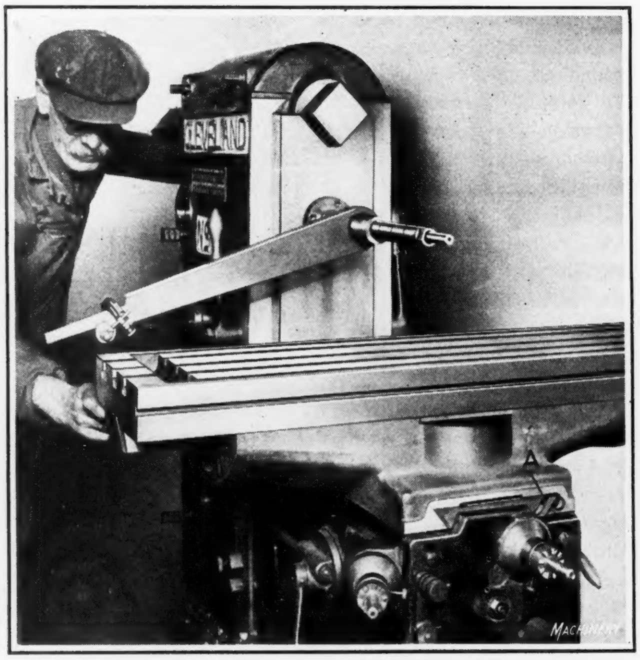


Fig. 4. Arm and Indicator used in squaring up the Table with the Spindle

spindle hole by means of a taper gage (here the diameter and taper of the spindle bearings must be noted); and amount spindle runs out at the mouth and at the end of a 15-inch test bar.

The inspector must also note whether or not the spindle bearings become overheated after a run of thirty minutes and must state if the machine has been run five minutes on each speed. The quiet running qualities of the gears when running idle and when under load must be stated on this report, as well as the correct rotative speed for the driving pulley. There must be no leakage of oil at any place in the column and the cutter lubricant pipes and valves must be a good fit at the joints. A tolerance of 0.002 inch is allowable in lining up the hole in the pendant for the arbor support with the center of the spindle. The distance the spindle nose extends beyond the face of the column must not be more than 0.032 inch under the nominal length. The inspector must furnish a definite answer concerning both these details and he must also check the diameter of the spindle nose to within limits of plus 0.000 and minus 0.0005 inch. The points mentioned only partly cover the complete question naire which has to be filled out by the inspector for every machine built.

Fig. 5. Boring the Arbor Support Hole in the Over-arm Pendant

Inspection of Knee, Saddle, and Table

A few of the questions contained in the inspector's report relative to the knee, saddle, and table are:

Is knee gib adjusted properly?

Does knee operate smoothly and at uniform resistance throughout its full travel?

Is saddle gib properly adjusted?

Does saddle operate smoothly and with uniform resistance throughout its travel?

Does cross-feed screw work smoothly and with uniform resistance throughout its travel?

Have graduations on saddle been correctly stamped?

Does table screw handwheel run true?

Does table quick-return bracket work smoothly?

Are slots in table correct to gage?

A similar set of questions pertains to the gearing and operation of the gears in the feed-box, and each of these questions must be answered in full. The following details regarding alignment should receive the inspector's attention, and where deviation from true alignment is noted, the amount of this deviation must be reported, as, for example, when testing the alignment of the spindle with the top of the ways on the knee, with the side of the ways on the knee, with the top of the over-arm, and with the side of the over-arm, on each of which there is a limit of 0.002 inch. In inspecting the top of the knee relative to the face of the column and to the ways of the column, the amount of error in 15 inches width must be noted. Similarly, the top of the table must be checked for parallelism with the top of the knee, and the variation in a length of 24 inches entered on the report. For checking the top of the table relative to the spindle and the T-slots of the table relative to the spindle, diagrammatic sketches are contained on the report so that the corner of the table which is high or low may be indicated.

Horsepower Tests

The inspector must further report the range of hand and power feeds for the longitudinal, cross, and vertical feeds for the table. All data regarding horsepower tests, both with and without load, such as the spindle revolutions per minute, kilowatts, voltage, and horsepower transmitted must be furnished. When working under load, a description of the material used in the test is required, as well as the cutter diameter, amount of stock removed, feed in inches per minute, speed of cutter in feet per minute, etc.

After the machine has passed these exhaustive tests and before it is ready for crating, special care must be given by the inspector to the tools and attachments to be included in the consignment, and the condition of these, as well as the provision for attaching them to the machine, must be noted. The entire list should be carefully checked with the shipping list and any deficiencies or improper parts reported. The machine is tested for appearance, with respect to painting, polishing, condition of screw-heads and nuts, and the rustproofing of parts so treated. Final provision is made on the report for the inspectors to furnish a summarized statement or to make notes regarding special points not fully covered in the report form. The inspector then signs and dates the reports, and these form a complete reference in case any question relative to the operation of the machine should be raised after it has been put into regular use.

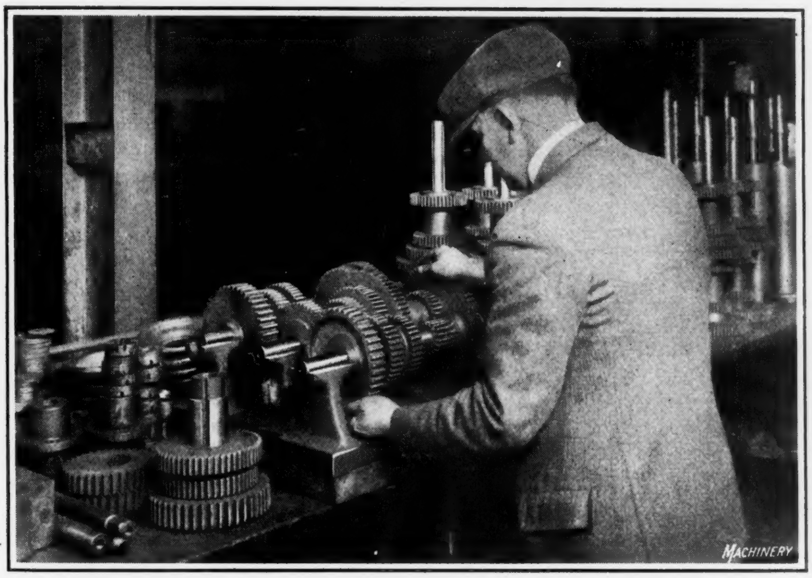


Fig. 6. Master Gage for testing the Running Qualities of the Speed Gear Train

Opportunities in the Machine Tool Industry

By FRED A. GEIER, President, Cincinnati Milling Machine Co., Cincinnati, Ohio

WHAT are the opportunities in the machine tool industry for young men about to choose their life work? This question is debated in the mind of many a young man today, and naturally so, because of the depression through which the machine tool industry has passed.

The main point that should be considered is the fact that the machine tool industry is the foundation upon which all other machine-building industries are built. It may have periodic depressions, but it also has periods of prosperity, and even during the depressions the men who have made a place for themselves in this industry as capable engineers or shop executives have retained their place. At the present moment some of the large firms in the field are looking for capable designers; and except for the unusual but somewhat uncertain opportunities that may be offered by some industry that has a sudden boom when it first looms up on the industrial horizon, it is doubtful if any other engineering industry offers a better field for earnest efforts, initiative, and ability than the machine tool industry.

The Type of Man who will Succeed

The conditions created by the war had a far-reaching effect upon men's minds. The tendency toward less seriousness of purpose is apparent everywhere, and the young men just starting life have been especially affected. The ease with which some fortunes were made during the war, either through pure speculation or through advantage being taken of the abnormal demand for goods of all kinds, created an impression that it will take many years to eradicate. Many seem to believe that it is possible to obtain a comfortable living, and even wealth, without a great deal of effort. The desire for pleasure and entertainment is greater than ever. The spare time of the younger generation is spent almost exclusively in the pursuit of pleasure, rather than in preparing for greater responsibilities in a successful business or engineering career. There is much less inclination to devote spare hours to study than in the years preceding the war, and the tendency to avoid serious effort is marked.

These tendencies of the times, however, create even greater opportunities for those whose minds are capable of serious endeavor, because there is actually less competition for the important places in the industrial field. The man who applies himself with earnest effort to his work stands out more definitely and will gain recognition more easily than in past years when such effort was more general. But it must be remembered that in the years to come, the ease of the war period will cease, and no success can be earned without hard and persistent work, any more than it could be attained without effort and application previous to the war. To the young man with a serious purpose, the machine tool industry offers at the present time an opportunity for usefulness and development at fair compensation.

Stability the Keynote in the Machine Tool Field

After all, the machine tool industry is one of the most stable of industries. Taking the established concerns in this field, the number of failures over a period of years has been exceedingly small. But it is not a "get-rich-quick" industry. It is not a speculative industry like the oil and mining business. There are no opportunities for gambling chances, but the young man choosing his life career should remember that for one gusher that may give wealth and easy riches, there are a hundred dry oil wells. For one lead of ore that furnishes profits to the mine operator, there are a hundred dead leads. There is an uncertainty that is not present in the machine industry. The speculative fields offer opportunities for a few men who are lucky. The stable industries—like the machine tool industry—offer steady employment with fair compensation to those who make good, and they need not take the gambling chances that are taken by those who look for "get-rich-quick" opportunities. In addition, the man engaged in the machine tool industry has the satisfaction of feeling that his work is necessary and useful to the world, because this industry is the basis upon which the entire civilization is built in a machine-made world like ours.

This satisfaction can never become part of the life of the speculator or the man engaged in enterprises the main purposes of which are to provide profits for the promotors. Even when these enterprises are not entirely dishonest in purpose, they are frequently entirely useless as far as the world at large is concerned, and are often intended to serve no other purpose than to provide an easy living for those who are able to influence the minds and pocketbooks of credulous investors and buyers.

The machine tool industry, on the other hand, is based on the one fundamental fact that it receives nothing except for value delivered. It must make good from month to month and from year to year. It must continue to produce machinery and appliances that will save money in production in other shops, and it can be based on no other qualities than honesty, integrity, and initiative.

The Needs of the Machine Tool Industry

Because of the purpose and position of the machine tool industry in the industrial structure, it constantly needs young men of a serious frame of mind, determination, ability, and progressive ideas. It is an industry that can never stand still. It therefore offers unusual and constant opportunities for the development of new ideas, and it places no limitations on the display of initiative.

We have just begun to develop machine tools along high productive lines. Only a few of the machine-building industries are as yet using machine tools to the best advantage, but as other industries become more and more specialized, the demand for machine tools that will produce more rapidly and more accurately will increase. In spite of the tremendous advance that has been made in machine tool design and construction during the last twenty or thirty years, perfection has by no means been reached in present designs. The years to come will doubtless see a great improvement in the capacity of machine tools. To carry this work forward, men are needed who have imagination coupled with a serious purpose. They must be able to conceive of new ideas; they must have the ability to do research work and to determine by experiments and analyses the lines along which the development of machine tool design must be carried on in the future.

The places of those men who are now the leaders in the field and who have brought the machine tool industry to its present point of development must be taken by a younger generation with new ideas and new enthusiasms. For men of the right type the machine tool industry offers an opportunity for a steady, honest, and useful life-work, with the satisfaction that comes from having filled a needed place in the world. As the industry grows and develops, the opportunities for greater usefulness and greater success will also grow.

Opportunities in the Machine Tool Industry

By J. B. DOAN, President, American Tool Works Co., Cincinnati, Ohio

THE question has been asked whether I consider the machine tool industry a worth-while field for young men to enter. Does it offer an opportunity to young men about to choose their life work?

To one who has been engaged in this industry for thirty years, this seems at first thought almost an unnecessary question, because there can be only one answer. But on further thought it will be realized that it is a natural question for a young man to ask, because if he has seen the industry only in the present depression, he may hesitate to become identified with it, even though his inclinations and abilities would fit him unusually well for this field. It is a peculiar trait of human nature to think, during a period of prosperity, that prosperous conditions will last forever; and on the other hand, in times of depression, it is natural to believe that business will remain in that state forever. In view of this, a few words from one who has been identified with the machine tool industry for many years may be helpful to younger men.

Fluctuations in the Industry

Practically every business has its high spots and low spots. This fluctuating condition is more pronounced in those industries whose products are not quickly consumed, and it is well known that machine tools have a comparatively long life—longer in fact than they should have for really economical production. Hence, the fluctuations are greater than in a business where the product is such that it is consumed practically as soon as it is produced, like agricultural products and clothing. As a general rule, the further an industry is removed from the ultimate consumer, the more marked are its fluctuations, and the building of machine tools being the basic industry—the beginning, so to speak, of all production in the manufacturing field—is therefore subject to more marked periods of prosperity and more definite and prolonged depressions than most other lines of manufacturing activity.

Constant Development in the Mechanical Field Requires Machine Tool Equipment

Anybody who knows anything about mechanics and mechanical devices realizes that they are becoming more and more an essential part of civilization; and they will probably become even more a part of everyday life in the future. New mechanical devices are constantly being developed to perform manufacturing operations formerly done by hand; to provide pleasure and entertainment, like the automobile, the phonograph, and the radio telephone; or for greater convenience like the many electrical devices for household use which have been placed on the market during the last few years. Machine tools are required for making all these devices. The future of the machine tool industry therefore is assured, because the demand for machine tools is as fundamental as the demand for agricultural products, clothing, or any of the prime necessities of life. The only difference is that the demands for the latter are constant, whereas the demand for machine tools is fluctuating.

The Need for High-grade Men in the Machine Tool Industry

The machine tool business is a difficult one. It requires a high grade of mechanical, executive, and business ability, and the men holding responsible positions in it must be capable of looking forward into the future. Because of the extremely high cost of designs, drawings, patterns, jigs, fixtures, time studies, etc., mistakes are very costly. This industry, therefore, requires the best type of brains—a type which should be well paid.

Both on the commercial side and on the engineering side the requirements are high. Men are needed who are capable of designing correctly the kind of machines for which there is a demand, and which will perform and produce in the customers' shops in such a way that a future demand is assured. Men are also required who are capable of manufacturing these machines in an economical manner, so that they can be sold at a price that will return a large enough profit for accumulating a sufficient surplus in good business years to tide the industry over the dull periods. This field also requires the highest type of selling ability, so that a properly designed and economically manufactured product may be sold in sufficient quantities to produce sufficient returns. All this requires a type of brains that can demand a satisfactory return for services rendered.

Service of this Industry to Other Industries

The abilities of the men engaged in the machine tool industry must also be such as to counteract the influences that are tending to break down the high standards of the industry in times of depression. At present the machine tool industry is passing through a discouraging period, because purchasers, instead of encouraging the development of better machines by being willing to pay a fair price, are doing just the opposite, and by attempting to beat down the price are hampering the development of better and more productive machines.

If this policy were pursued for a sufficient length of time, it would bankrupt the entire machine tool industry, and the principal sufferers in the long run would be the users of machine tools who must have them in order to produce economically and in sufficient quantities the goods which they sell. It requires great ability to counteract these influences that are tending—unintentional though it may be—to wreck the industry. Buyers of machine tools must be informed of the truth of the situation in such a manner that they are able to see that the welfare of the industries in which they themselves are engaged depends upon the welfare of the machine tool industry. To carry on this work among machine tool buyers requires a type of man of unusual abilities who must be well paid.

To sum up the whole situation, the machine tool industry unquestionably offers inducements to young men who have the proper qualifications. Because of the many difficult problems that confront this industry, there is plenty of room in it for men who have foresight, courage, stamina, and integrity. This type of man, in whatever industry he is engaged, must be well paid, and because the opportunities to display ability are greater in the machine tool industry than in many other fields, the possibilities for success are also greater. Gradually the industry is becoming more and more aware of the fact that, with proper management, it can bridge over the periods of depression by foresight and conservative action during the prosperous years. The machine tool industry should be judged, not by its periodic booms and depressions, but by its constant development and progress over a long period of years. The development of the machine tool industry in the United States during the last thirty years is proof of the possibilities, the stability, the usefulness and the permanency of this industry.

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HOOVER ON COOPERATION

In his address before the executives and secretaries of trade associations at the recent Washington conference, Secretary Hoover referred to the cooperation of his Department with several organizations that have appointed special committees to give "direction and strategy to the agencies of the Department of Commerce abroad on behalf of the whole industry," thereby facilitating closer cooperation between the Department and the automobile and rubber industries, as well as others.

Secretary Hoover is not trying to force this kind of cooperation upon the industries. He is offering a service that has never yet been performed by our Government, although before the war similar services were rendered by the German Government to its manufacturers, which helped the wonderful extension of their foreign trade—that in machine tools alone having increased over 1000 per cent between 1904 and 1914. Cooperation cannot be effected by one party to the effort alone, and American manufacturers who are interested in foreign trade must show their active interest in this work, or it will amount to little.

The machine tool building industries represented in the Department of Commerce by the Industrial Machinery Division have not formed a special committee to cooperate, although apparently it would be of considerable advantage to them, and especially to those engaged in the metal-working machinery field. The larger manufacturers may be able, through special representatives, to investigate foreign markets sufficiently for their needs, but the great number of small manufacturers in the metal-working machinery field cannot afford to undertake such work, nor to maintain an information service that keeps them in touch with foreign developments affecting them.

If the smaller manufacturers are to be kept informed about the possibilities in foreign markets, a cooperative arrangement with the Department of Commerce is of great importance. A special committee to keep in close touch with the Department, and especially with the Industrial Machinery Division can greatly help the latter in its work, by pointing out specifically the lines of inquiry along which the Department can be of the greatest service. Several of the leading trade associations and societies in the mechanical engineering fields, such as the National Machine Tool Builders' Association and the American Society of Mechanical Engineers, might well unite in forming such a committee, the members from the latter society representing manufacturers of industrial machinery and equipment other than machine tools. This effort should especially appeal to all manufacturers who are interested in exports, and the mounting values of foreign exchange mark the present as the time when such an effort should be initiated.

* * *

BUILDING UP GOOD WILL

Good will is worth millions to many great enterprises, and is a substantial part of the assets of many small ones. This factor of value is based almost entirely upon the confidence of the buyer in the manufacturer or dealer, and every machine tool builder knows well that the closing of a sale is often only the beginning of his relations with the buyer. The machine sold must make good in the customer's shop. It must prove to be the kind of machine best suited for his work, and if it develops unexpected defects, the seller must make good or lose the buyer's confidence.

In building up good will in the machinery field no factor is more important than the suitability of the machine to the customer's needs. If it is too heavy or too light, or in any other way unfitted for the work it was bought for, it is a poor sale and the manufacturer may eventually lose more than his profit, because the customer will soon learn that he made a mistake which he could have avoided if the seller had cared to give him honest advice as to the kind of equipment best suited to his needs.

The truisms mentioned above apply also to a variety of products. The manufacturer of leather belting, who is familiar with the conditions under which his product is to be used, can give advice that will save his customer money. If the manufacturer of gearing is familiar with the kind of service the gears are required to render, he may be able to advise his customer on a selection of gears that will be better for the work than those the buyer originally intended to get. Sometimes for this reason the sale may be smaller and the profits less; but the profit chargeable to good will cannot be estimated in dollars and cents, for the customer who has been given honest advice will return with more business. Some far-sighted manufacturers refuse to make sales of their product for uses in which they are unlikely to make good.

* * *

THE VALUE OF APPRENTICESHIPS

What are the chances of success for the boy who completes a regular apprenticeship, as compared with one who simply goes to work in a shop as an operator and expects to pick up some knowledge of the trade while earning a regular operator's wage? Voluminous statistics would be necessary to answer this question accurately; but the experience in a few plants where records have been kept of apprentices shows the great value of systematic training in shop work. In a comparatively small shop in Michigan, the proprietor made it a rule to take in a certain number of apprentices every year. He put them through a rather strenuous course of training and many of the boys dropped out, partly because the work was hard and partly because they could earn more as machine operators in other shops; but the success of those who completed their apprentice course proved that they did not pay too high a price for their training. All but one of those who finished their apprenticeships of four years are today either superintendents or foremen, and five of them own their own shops.

Another manufacturer states that about 50 per cent of the apprentices taken into his plant completed their apprenticeship, and of those who did so the majority are today either superintendents or foremen, or hold other positions of responsibility. A Cleveland machine tool manufacturer who has maintained an apprenticeship system for forty years, has kept a record of those who have learned their trade in his shop, and the list includes several well-known manufacturers and shop superintendents, as well as a large number of successful salesmen and foremen.

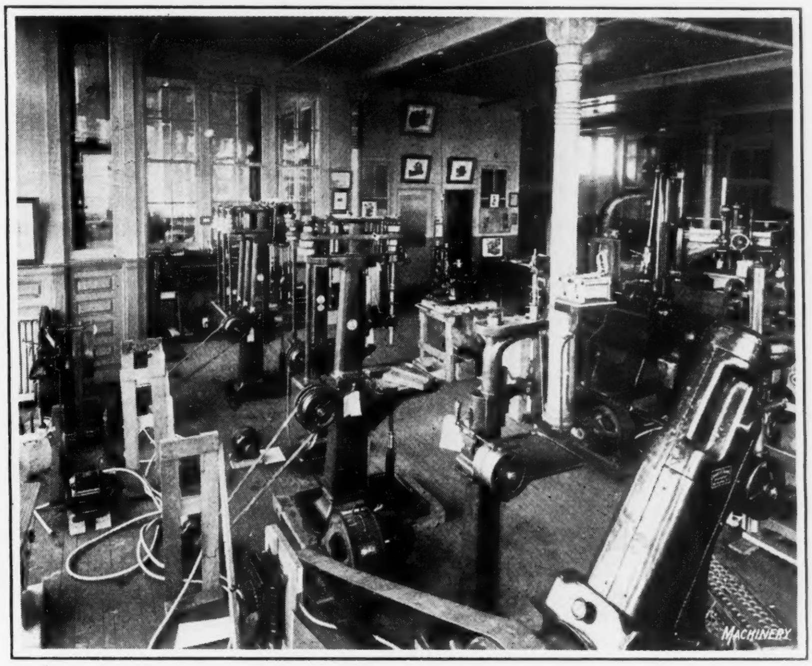
The National Metal Trades Association is working successfully to interest its members in a systematic plan for establishing apprenticeships which doubtless will prove of practical value, both to the young men who take up this training and to the industry generally. This plan should have the support of all manufacturers.

Selling Machine Tools by Demonstration

By OGDEN R. ADAMS, Rochester, N. Y

DURING the past a great deal of effort has been made to sell machine tools by letters, catalogues, and circular matter, but little or no attempt has been made to demonstrate to the prospective customer what can actually be done with the machine tools on the market. The only way in which a customer can be thoroughly convinced as to the superior qualities of a machine is by an actual demonstration of its work. This sales method has been almost entirely neglected in the United States.

The entire mechanical field has been advancing rapidly during the last few years, and the machine tool manufacturer, representing a basic industry, has had to step lively in order to keep ahead of the procession. He has been able to do this, however, and there are a great many machines on the market today that are far superior to those that were available, say, ten years ago—or even five years ago. In consequence of this, hundreds of men who have been running shops that were well equipped with modern machines several years ago, and who have settled down to what they consider to be approved methods of production, are not familiar with the improved types of machines which the machine tool manufacturers have placed on the market during the last few years. These new machines in some cases are improvements on former types; in other cases they have been developed from the ground up, representing entirely original ideas, and are placed on the market as competitors of other types of machines that were formerly used for doing the same kind of work.



Modern Method of showing, by Actual Demonstration, what Results can be obtained from Different Types of Machine Tools

The Value of Dealers' Demonstrations of Machine Tools

A few years ago I conceived the idea of inviting the manufacturers from various parts of the country to my showrooms in Rochester in order to give them an opportunity to see newly developed machines, operated by expert demonstrators, performing actual work. My experience has taught me that this method is a valuable one, and that by following some such practice it is possible to create a great deal of interest, not only among the local and nearby manufacturers but among their employes as well. These men have gone to considerable trouble to come to the annual demonstrations, which now seem to take the form of an annual reunion of the men. Some come in intending to stay a few minutes only, but when they see the value of the demonstration, they remain for hours. This bringing together of men from different factories also gives them an opportunity to exchange views and ideas along mechanical lines, which in many cases has proved mutually helpful.

General Principles of Machine Tool Demonstrations

When a machine tool demonstration is arranged for in the show-rooms of a machine tool dealer, it should be planned with considerable care. Experienced mechanical men do not wish to see a standard machine tool being operated. It is of no particular interest to them to see an ordinary lathe producing an ordinary chip. What they wish to learn is how rapidly good work can be produced on different types of machine tools or how accurately work can be produced by an average operator. They want to know about the newest types of machines for producing work of a certain quality in the quickest possible time. They are interested in the safety devices for the protection of the operator, and in all kinds of improvements in design for the rapid and convenient handling of work. Furthermore, they are interested in the conservation of floor space, a point that can be very effectively demonstrated in the exhibition rooms of a machine tool dealer.

All these various things have been successfully demonstrated and it is not a mere theory that such demonstrations can be made successful. The machine tool manufacturers naturally are enthusiastic over the opportunity to have their machines exhibited, and generally they are glad to supply demonstrators and experts to explain thoroughly the operation of the machines and the new ideas that have been incorporated in their design. Another advantage of this local demonstration is that it is possible for the dealer to obtain local work for demonstration purposes. He can then show by actual performance how it can be done to better advantage on the machines in operation in the show-room than it is at present in the prospective customer's shop.

Taking Care of the Human Side

In making a success of a machine tool demonstration in the show-rooms of a dealer, it is necessary, in order to sustain the interest, to furnish not only serious food for thought to the visitors, but also to appeal to their sense of humor and to provide for the "inner man." Educational features should be introduced in the nature of talks by authorities, and these should be illustrated, if possible, by stereoptican views. In the demonstrations held in the writer's showrooms in Rochester, an opportunity has also been provided for testing the manual skill of the visitors, or their quick brain action in overcoming some difficult problem, and to stimulate interest prizes have been awarded for the performance of some particular kind of operation.

It is important, if these demonstrations are started, that they must not be considered as a single effort held only once, but they should be made an annual function of the machine tool dealer's business, and should be conducted in a dignified, constructive, and instructive manner. In Europe machine tools have been sold by demonstration for years, and in a great many of the European show-rooms machines are under belt at all times, and expert operators are employed who can start and operate any machine when a customer calls.

Such methods would be of great value in the United States as well. At first, however, it might be necessary to limit the efforts to annual demonstrations, while later on permanent demonstrating rooms could be maintained. A few of the manufacturers of machine tools now maintain demonstrating rooms in their factories, but I believe, as the pioneer in this country in the adoption of a dealer's demonstration, that I have struck the right keynote for the most effective advertising covering a limited territory, and the right method in which to instruct prospective customers in regard to the machine tools handled. The results obtained thus far have thoroughly proved the accuracy of our opinions and the success of our endeavors.

By carefully planned demonstrations, it is possible to make every city of any size in the machine shop centers of the country an attractive center for machine tool buyers. By such efforts local dealers would be able to obtain a stronger grip upon the local machine tool trade, and they would come into closer contact with their customers.

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GERMAN MACHINE TOOL PRICES

By MACHINERY'S Special Correspondent

Berlin, June 10

The German machine shops are fully occupied, but there are complaints about a scarcity of coal, a falling off in export orders, an increasing scarcity of credits, and slow collections. Many plants are working over-time. Sales are made at sliding prices only, and the domestic prices in many cases exceed those offered foreign buyers. As an example may be mentioned aluminum goods, which have become too expensive for domestic buyers.

The demand for locomotives is brisk. Several orders for bridges for South America have been booked, as well as orders for railway equipment; but Belgian competition is becoming keener, and a large Belgian iron works has underbid German firms in many cases. One bid on rails for Bulgaria shows the Belgian price as 14 per cent below the German. On bids for railway car wheel tires, pipes, metal ties and plates, German prices in recent bids have been from 16 to 34 per cent above Belgian prices.

The price per pound of machine tools, as expressed in marks, is constantly rising. In many instances it is now from 28 to 32 marks per pound. Some examples of prices current in the month of April are given in the following:

Prices of Stock Machines

18-inch engine gap lathes (with feed-rod), distance between centers 60 inches, weight 3740 pounds, 70,000 marks (present exchange, about $235).

Bolt-cutting machines, height of centers 8 inches, distance between centers 50 inches, weight 2000 pounds, 43,000 marks (present exchange, $145). The same type with height of centers 6¼ inches, distance between centers 24 inches, weight 1540 pounds, 38,500 marks (present exchange, $130).

Planers, working length of table 60 inches, width 36 inches, working height 30 inches, weight 9900 pounds, 210,000 marks (present exchange, $700).

Shapers, stroke of ram 22 inches, weight 3300 pounds, 75,300 marks (present exchange, $250).

Oil-grooving machines with single-pulley drive, weight 2530 pounds, 50,000 marks (present exchange, $165).

Prices of Machines Made to Order

Small thread-cutting machines for cutting brass threads up to 0.20 inch in diameter, 3600 marks (present exchange, $12); up to 0.80 inch in diameter, 10,200 marks (present exchange, $34).

14-inch production lathe, distance between centers 36 inches, weight 2090 pounds, 48,400 marks (present exchange, $160).

24-inch engine lathe, distance between centers 50 inches, weight 8360 pounds, 190,300 marks (present exchange, $635).

18-inch engine lathe (Wohlenberg), distance between centers 60 inches, weight, 3475 pounds, 68,100 marks (present exchange, $225).

Radial drilling machines (high-duty), with motor drive, working radius 72 inches, working height 80 inches, weight 15,840 pounds, 440,000 marks, not including electrical equipment (present exchange, $1465).

Radial drilling machines, with motor drive, capable of drilling holes up to 2.6 inches in diameter, working radius 70 inches, working height 64 inches, weight 10,780 pounds, including electrical equipment, but without table and foundation plate, 308,250 marks (present exchange, $1025).

Radial drilling machines for drilling holes up to 2 inches in diameter, working radius 88 inches, working height 56 inches, weight 6775 pounds, 145,150 marks (present exchange, $485).

Plate-straightening machines for rough plates, ¼ inch to ¾ inch thick, 106 inches wide, 1,203,000 marks (present exchange, $4000).

Duplex nut milling machine, table surface 10 inches wide by 44 inches long, weight 4350 pounds, 98,500 marks (present exchange, $330).

Circular plate shears capable of handling plates 0.120 inch thick and 40 inches in diameter, weight 814 pounds, 22,000 marks (present exchange, $73).

Planer, working length of table 100 inches, width 60 inches, and working height 50 inches, weight 26,400 pounds, 560,000 marks (present exchange, $1865).

Cold saw (heaviest pattern), diameter of saw 48 inches, weight 18,525 pounds, 285,300 marks (present exchange, $950).

Lathe chuck (Cushman type), diameter 2¾ inches, 600 marks (present exchange, $2); diameter 10⅝ inches, 2100 marks ($7); diameter 18⅞ inches, 7500 marks ($25).

* * *

In a recent number of the Journal of the Franklin Institute, mention is made of the application of what has been termed the "ultra-micrometer" to the measurement of small increments of temperature. This is an electrical device so sensitive that it is said to be possible to detect a change in temperature of one-sixteen thousandth of a degree Centigrade or a change in length of one two-hundred millionth of an inch. By this arrangement the expansion coefficient of copper can be measured by raising the temperature a single degree.

* * *

VALUE OF MACHINE TOOLS AND METAL-WORKING MACHINERY EXPORTED TO ITALY, 1912-1921

Year*	Lathes	Sharpening and Grinding Machines	Other Machine Tools	Total of Machine Tools	All Other Metal-working Machinery	Total of Machine Tools and Metal-working Machinery
1912	......	......	......	......	......	$273,344
1913	......	......	......	......	......	437,910
1914	......	......	......	......	......	421,603
1915	......	......	......	......	......	511,134
1916	......	......	......	......	......	4,779,178
1917	......	......	......	......	......	8,771,496
1918	$1,103,629	$518,606	$1,246,257	$2,868,492	$2,208,386	5,076,878
1919	73,331	138,668	600,877	812,876	1,079,194	1,892,070
1920	152,034	106,218	641,488	899,740	589,078	1,488,818
1921	2,972	11,575	65,151	79,698	159,572	239,270

Machinery

*Amounts given are for fiscal years, up to and including 1918, and for calendar years thereafter. The Department of Commerce statistics did not give machine tool exports separately previous to 1918.

Making Radio Parts

By FRED R. DANIELS

The Use of Lathes and Other Machine Tools in Radio Shops

PERHAPS the most general use of lathes in radio manufacture is for winding tuning coils, rheostat coils, etc. The winding of a tuning coil, as done in the plant of the DeForest Radio Telephone & Telegraph Co., is shown in Fig. 1. These coils are wound on uncolored bakelite tubes. The uncolored material is used because it has been found that a better current inductance is obtained from tubes made of material that contains no coloring matter. The coils are wound with No. 26 gage enameled wire, which is run from a reel at the front of the lathe, and guided by the operator as shown. The tube fits over a cylindrical wooden block attached to the lathe, and the wire is passed through holes drilled in the end of the tube and is extended to permit suitable connections to be made in the circuit. This operation is performed on a Seneca Falls tool-room lathe. After the winding operation has been completed, the wire is severed and threaded through corresponding holes at the opposite end of the tube in order to anchor it.

The DeForest rheostat consists of a molded bakelite base to which a resistance coil, wound on a strip of fiber, is attached. The fiber core of the resistance coil is shown in the upper part of Fig. 3, and the special winding fixture in Fig. 2. The fiber is 1/16 inch thick by 5 9/32 inches long, and it was found necessary to employ a special fixture to prevent it from twisting and buckling during the winding operation. There are 117 turns of No. 23 B & S gage nickel-plated resistance wire wound with twenty-six right-hand turns per inch. The length of the wire is 10½ feet. The fixture used was designed by Mr. Reber, the chief toolmaker of the DeForest company.

The spindle of the lathe carries a pinion which drives, through suitable gearing, two ½-inch lead-screws having thirteen threads per inch, on which the carriage *A* of the fixture travels during the winding operation. The fiber is prevented from twisting by driving the chucks that hold both ends of the strip positively, the drive for the tail-end chuck *B* being from a pinion within the carriage, carried on the splined shaft *C*. This construction permits the pinion on shaft *C* to slide along with the carriage as the coil is being wound and to drive the chuck *B* at the same rate of speed as the chuck *D* at the head end. It will be seen that with twenty-six turns per inch and a lead-screw having thirteen threads per inch, a gearing ratio of two to one is required to give the proper rate of carriage traverse.

The fiber strip is tightened in the head-end chuck by the hollow set-screw wrench *E*. The hole in the set-screw in the chuck goes clear through, so the wire may be passed through it and through a hole in the fiber, before starting the coiling operation. Previous to this the two lead-screw nuts *F* are released by the thumb-screws which hold the two halves together, and the carriage is advanced to the head end, preparatory to starting the operation. A flat strip attached to the top of the carriage helps to support it, and carries a mark to indicate when the correct number of turns have been wound. The wire is passed over two buttons on the side of the carriage, which guide it and maintain the proper tension. When the winding is finished the operator cuts off the wire with a pair of pliers, releases the lead-screw nuts and the head-end chuck, and slides the carriage to the right far enough to remove the coil. The coil is then replaced by another fiber strip and the carriage moved to the head end. The fiber, which is now extending through the foot-

Fig. 1. Winding a Tuning Coil in a Lathe

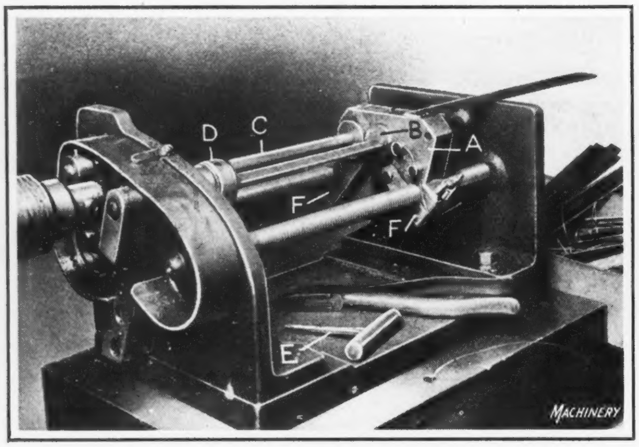


Fig. 2. Winding Fixture used on a Lathe for making Rheostat Coils

end chuck or slotted bushing on the right-hand side of the carriage, is tightened in the head-end chuck and the wire threaded through, as before.

Some Uses of Bench Lathes

The winding of variometers, which are used in regenerative circuit radio receiving sets, is done at the Adams-Morgan plant in a bench lathe. The exterior winding on the rotor member of the instrument is performed with no special means of guiding the wire other than the judgment of the operator. The interior windings of the stator member of the variometer require a special guide on the bench lathe for the wire, and this guide extends within the hollow stator, the interior surface of which is coated with shellac in which the windings are embedded. Aside from the means for reaching in to guide the wire, no other special provision is made for doing this work.

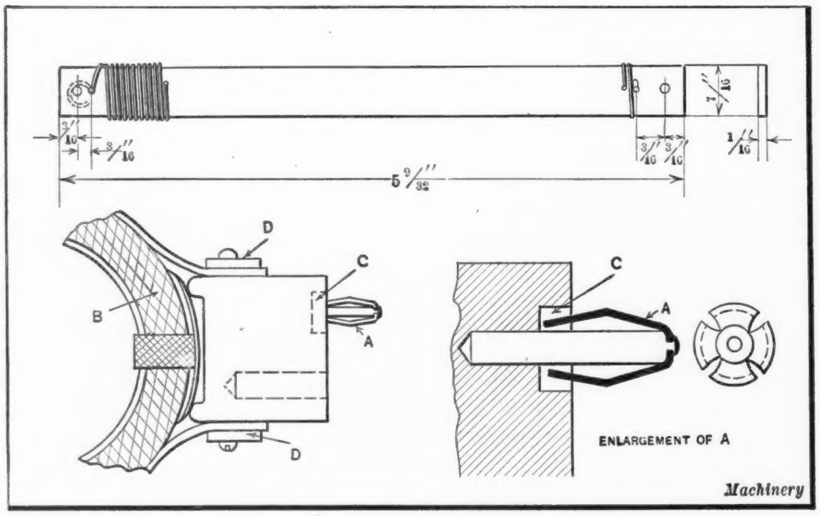


Fig. 3. (Above) Fiber Strip for Rheostat Coil Winding; (Below) Honeycomb Coil and Enlargement of its Spring Contact "Plug-in"

A number of the rotors may be seen in Fig. 4, where the operator is shown straightening the rotor shafts, with hand tools, two anvils being used to support the work. This illustration shows the character of the windings. Incidentally, attention is directed to the receiving set which is shown directly in front of the operator. The unit at the extreme right is a vario-coupler. It consists of a primary and a secondary winding, the primary coil being mounted at a 45-degree angle within the secondary, so that the windings may be variably coupled by turning the drum on which the primary coil is wound. Next to the vario-coupler is a plate condenser which, though not absolutely necessary in regenerative sets, is used to sharpen the tone. The unit at the left is a variometer; this view shows the mounting of the stator and indicates how the rotor is operated within it. The primary winding, in this case, is on the outer member, or stator.

The use of bench lathes as auxiliary equipment for finishing screw machine products is quite general in the radio manufacturing field. Indicator arms and switch points that are assembled by spinning to brass bushings molded in non-metallic knobs, may be conveniently cleared of the burr produced in the bushing hole, by the use of a bench lathe. Small hand tapping jobs, of which there are a large variety, are also suitable bench lathe radio jobs. Other typical bench lathe work commonly found in radio shops includes smoothing the heads of brass screws with a small emery-faced wooden disk, burring and beveling shoulder screws, and countersinking holes. Fig. 5 shows a battery of Sloan & Chace bench lathes used in the DeForest plant for a wide variety of work of the class to which reference has just been made.

Lathes for Spinning Horns

Horns of various types are employed for use in connection with an amplifier, the sound being delivered from the receiver of the instrument and thrown out so as to be heard without the use of head-phones. The type of "loud speaker" manufactured by the Radio Service & Mfg. Co. is known as an "amplitron." This is not of the familiar graphaphone horn type, but is slightly different in construction from those in common use.

The "amplitron" is cone-shaped, and this cone is fastened to a suitable stand by means of which it is supported in an upright position. The open end of the horn has a flange to which three radial strips are fastened which support a cup at the center, into which an ordinary telephone receiver may be screwed. The instrument is shown on the ways of the lathe in Fig. 6. Leading from the rear of this receiver cup, there is a small horn through which the sound is carried back to the apex of the cone, where it is reflected and amplified. The wide angle of the cone is designed to eliminate distortion of sound. The cone is 10 inches in diameter and 7 inches deep, and it is made from No. 23 gage sheet copper.

Four distinct operations are required in spinning this copper cone; that is, four different spinning chucks are used. The shaping of the cone is not completed until after the third operation, when the work is annealed preparatory to the finish-spinning operation, which is shown in Fig. 6. The chuck or form

Fig. 4. Straightening the Shaft of a Variometer Rotor

is made from hard maple, polished nicely, and the operation is performed on an 18-inch lathe, the tailstock of which is equipped with a ball bearing center. After greasing the wood form with albany grease, the shell is placed over it so as to run true. Four tools are used in the operation; the first has a rounded end like the bowl of a spoon, and is called a point-and-ball. This is the regular finishing tool, but it is used first to shape the apex and to work the metal back for a distance of about one inch from the apex. A small hard wood center is used between the apex and ball-bearing center during this step, but it is discarded afterward for a larger one which is employed during the remainder of the spinning operations.

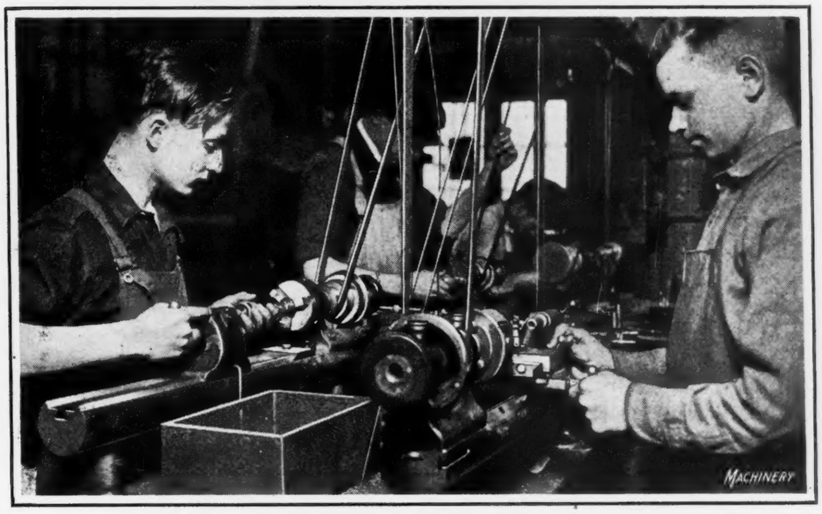


Fig. 5. Battery of Bench Lathes on which Numerous Minor Operations are performed

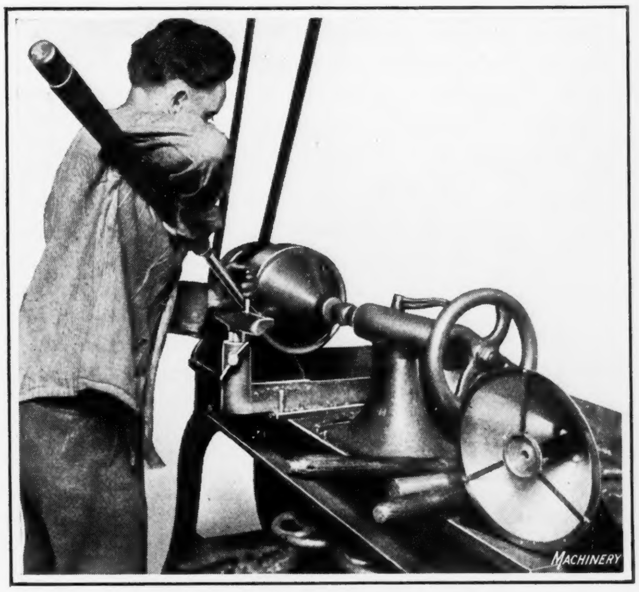


Fig. 6. Spinning a "Loud Speaker" Horn

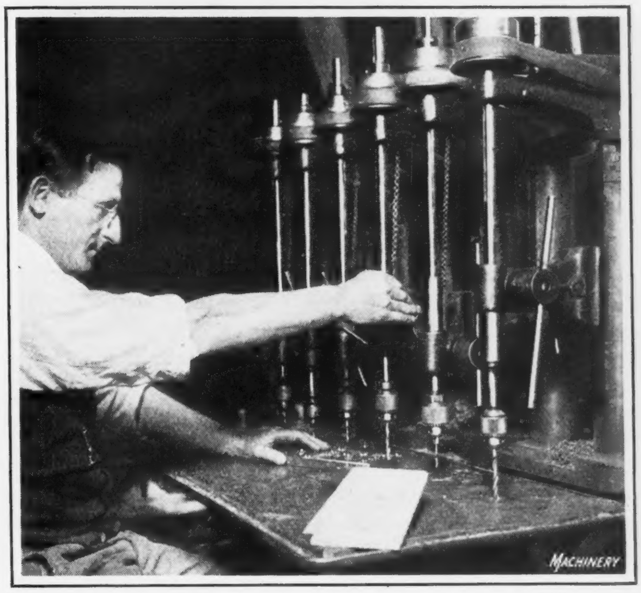


Fig. 7. Drilling Panels for Receiving Sets

The next tool is the one shown in use in the illustration; this has a blunt point on the end and a very long handle to provide the proper amount of leverage. During this operation the position of the tool on the T-rest is changed as the work progresses by transferring the fulcrum pin from hole to hole in the rest, so that the desired leverage for the tool is obtained. By the time the operator has reached the large end of the shell near the flange the diameter has increased to such an extent that he has to work in an extremely limited space, necessitating a somewhat cramped working position. This tool is brought up to the flange and across it, and then the smoothing tool is used again, this time to go over the same surfaces. Before this tool is used, the shell is greased. Lubricating the shell reduces the friction between tool and work. The corners of the flange are then trimmed with a square-edged tool, preparatory to forming the bead at the edge.

In curling the edge of the flange, a pair of hook pliers is used, supported on the T-rest by a piece of wood held in one hand while the spinner uses the pliers in the other to turn the edge. The turned edge is then beaded with a tool which carries a roll at the end. After the bead has been formed, the hard wood center is removed and the smoothing tool used to finish the apex of the shell which has now been exposed by the removal of the wood plug. It will be understood that in using each of these tools any one of several holes in the T-rest may be

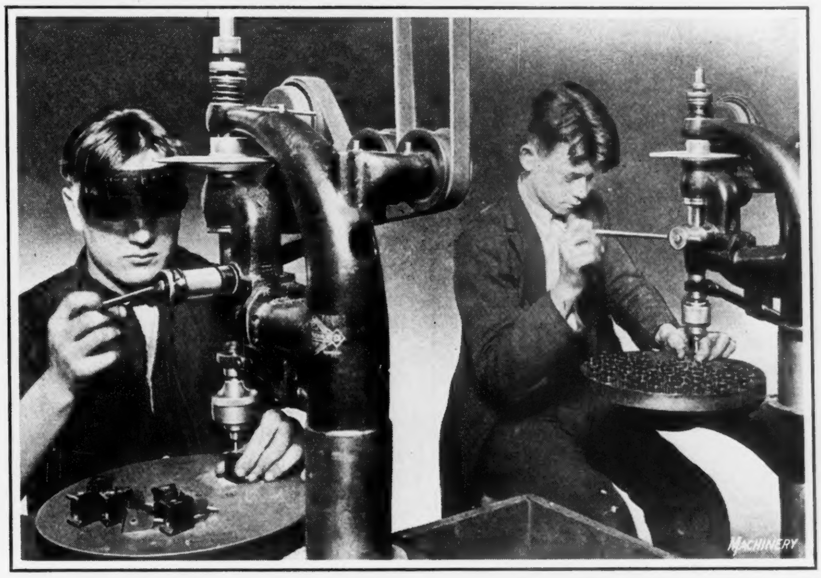


Fig. 8. Two Different Tapping Operations required on Radio Parts

employed for the leverage pin, to suit the convenience of the operator.

Work on Drilling and Tapping Machines

The examples of the use of drilling and tapping machines on radio work here illustrated were obtained at the plant of the DeForest Radio Telephone & Telegraph Co. The first is the drilling of thirty-three holes in the wooden panels used in the receiving sets of this company's manufacture. The panels are made of walnut and are used on crystal detector sets. They are located in a flat plate-type jig, and the operation is performed on a six-spindle Prentice drilling machine, as shown in Fig. 7. There are thirteen No. 51 drill holes, seven No. 31, four No. 27, five No. 18, two F size, and two 5/16-inch holes drilled in this sized panel.

The use of a three-spindle Allen drilling machine is shown in Fig. 9; in this view the two end spindles are being used on two different spinning operations. The contact spring *A*, Fig. 3, used in the DeForest honeycomb coil *B* and in its mounting, is assembled to a stud molded in the bakelite plugs by spinning. This operation is being performed under the first spindle, in which a roll spinning tool is used. The hole in the center of the thimble-shaped spring is slipped over a teat on the end of the stud molded in the bakelite plug, and is then secured by a spinning operation. The material surrounding the base of this stud over which the contact spring is spun, has a molded recess *C*, Fig. 3, to receive the ends of the spring and prevent them from spreading or becoming misshaped due to being repeatedly plugged into the coil mounting.

The operation being performed under the farther spindle of the machine illustrated in Fig. 9 is the spinning of brass bushings, molded in control knobs, as a means of securing phosphor-bronze indicator pointers to the knobs. The knobs are molded from bakelite, and the inserts have a shoulder at the end over which the indicator pointer seats.

The clips *D*, Fig. 3, by means of which the fiber strips are bound to the honeycomb plugs, are secured in place by machine screws, and the plugs are tapped to receive these screws on Rickert-Shafer tapping machines. This operation is shown at the left in Fig. 8. The holes have a 6–32 thread, and the material is molded condensite. The other tapping machine of the same type shown in this illustration is engaged in tapping a hole in the shanks of bakelite knobs. A wide variety of knobs of this general type are used in radio apparatus, some of which are attached by machine screws, while others are molded with inserts and have pointers assembled by spinning, as previously mentioned.

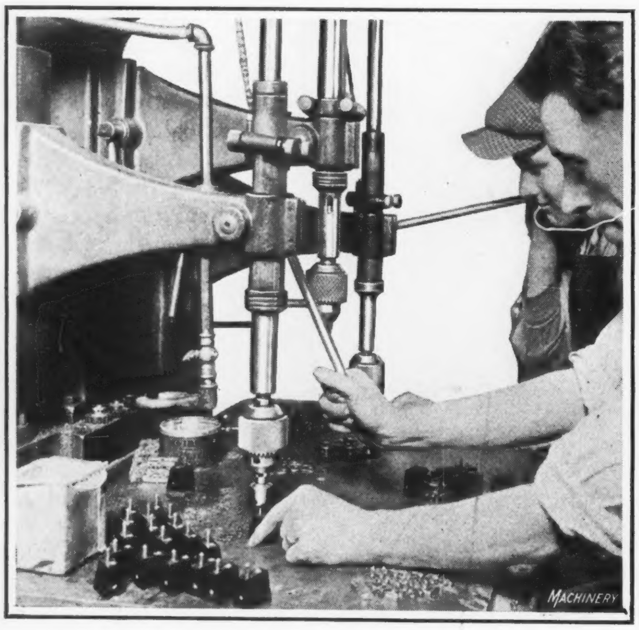


Fig. 9. Two Spindles of a Three-spindle Drilling Machine used for Spinning Operations

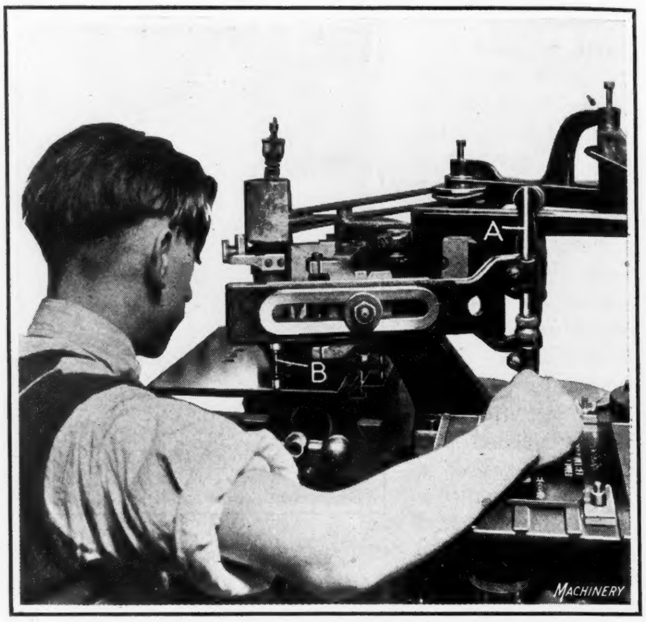


Fig. 10. Engraving Bakelite Tuner Panels on Pantograph Engraving Machine

Use of Pantograph Engraving Machines for Radio Work

Fig. 10 shows a pantograph engraving machine engaged in engraving DeForest long-wave tuner panels. These panels are sheet bakelite, and are engraved with the maker's name and various other notations regarding the type of instrument, the function of the different control knobs and switch contact points, etc. The stylus point is carried in spindle *A* and is moved by the right hand of the operator along the letters in the master plate which is attached to the table. The engraving tool is shown at *B*. The panel which is being engraved is attached to a table by clamps in the regular manner. Some of the machines used are built by the George Gorton Machine Co., and some are of German manufacture.

* * *

NATIONAL INDUSTRIAL ADVERTISING ASSOCIATION

During the annual convention of the Associated Advertising Clubs of the World held in Milwaukee June 11–15, an organization known as the National Industrial Advertising Association was formed. The following officers were elected: Keith J. Evans, Joseph T. Ryerson & Son, Chicago, president; P. C. Gunion, Hyatt Roller Bearing Co., New York City, vice-president; H. N. Baum, Celite Products Co., Chicago, secretary; A. K. Birch, Allis-Chalmers Mfg. Co., Milwaukee, treasurer. The following board of directors was elected: Julius Holl, Link-Belt Co., Chicago; L. F. Hamilton, Walworth Mfg. Co., Boston; W. A. Wolff, of the Western Electric Co., New York City; P. A. Powers, Benjamin Electric Mfg. Co., Chicago; H. J. Downs, American Locomotive Co., New York City; E. W. Clark, Clark Equipment Co., Chicago; H. L. Delander, Crane Co., Chicago; Bennett Chapple, American Rolling Mills Co., Middletown, Ohio; and J. C. McQuiston, of the Westinghouse Electric & Mfg. Co., Pittsburg.

The object of the new organization is to hold a conference in connection with every annual convention of the Associated Advertising Clubs of the World, the purpose being to gather together the leaders in industrial advertising for consideration of methods to improve the standards of advertising those products which are sold by one manufacturing plant to another. The problems involved in handling such publicity are necessarily different from those which arise in other classes of advertising. It is believed that the development of an organization for the free exchange of ideas on this subject will prove of great mutual benefit to those who participate.

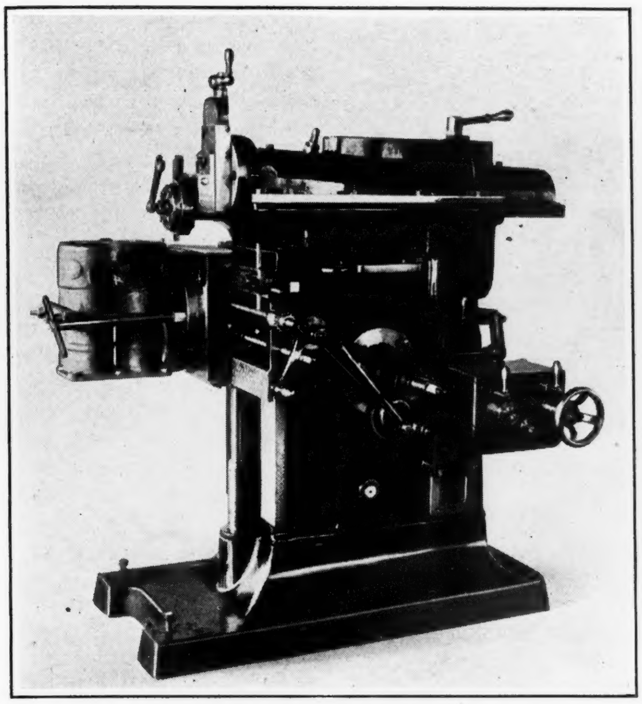


Fig. 1. Equipment used for machining the End of an Automobile Cylinder Block on a Shaper

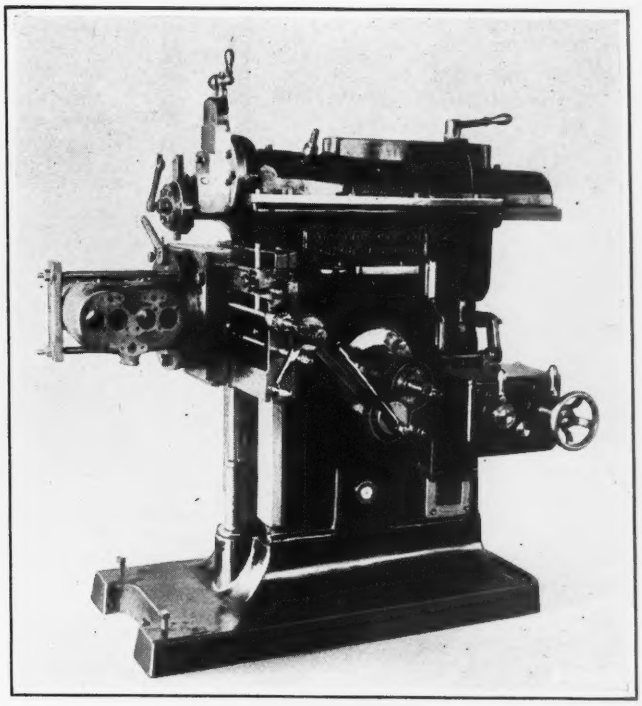


Fig. 2. Using the Equipment shown in Fig. 1 for shaping a Side of the Cylinder Block

The Shaper as a Manufacturing Machine

THERE are some classes of work on which the shaper may be used profitably as a manufacturing machine. Examples of such work are shown in this article. Most of the work illustrated was performed in the plant of the Smith & Mills Co., Cincinnati, Ohio, and all was done on shapers built by that company. Brief references only are made to the methods of performing the work, as the illustrations are self-explanatory, showing clearly both the method of holding the work and the tooling arrangement employed in each case. These examples will doubtless suggest similar applications in other plants.

Figs. 1 and 2 show a shaper engaged in machining automobile cylinders. This work was formerly done on a milling machine, but it was found more economical in this case to use a shaper, because of the saving of a double set of milling cutters. The holding fixture used on the shaper is the same as that which was formerly used on the milling machine. This is an indexing fixture, with a plunger-pin for

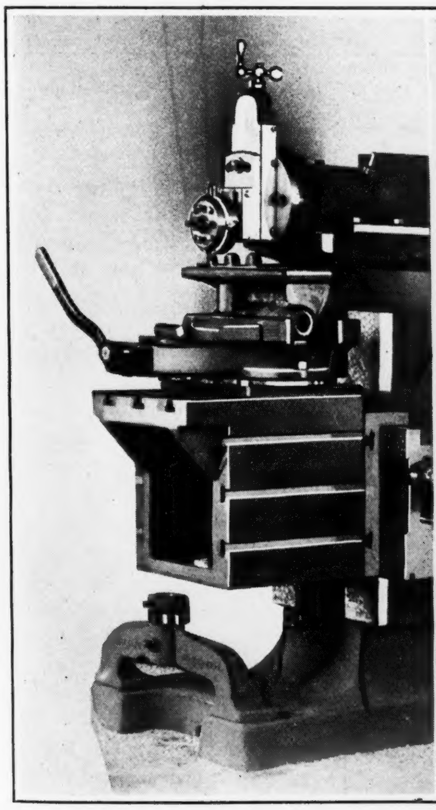


Fig. 3. Shaping the Top Casting of a Tailstock

Fig. 4. Operation on a Lower Tailstock Casting

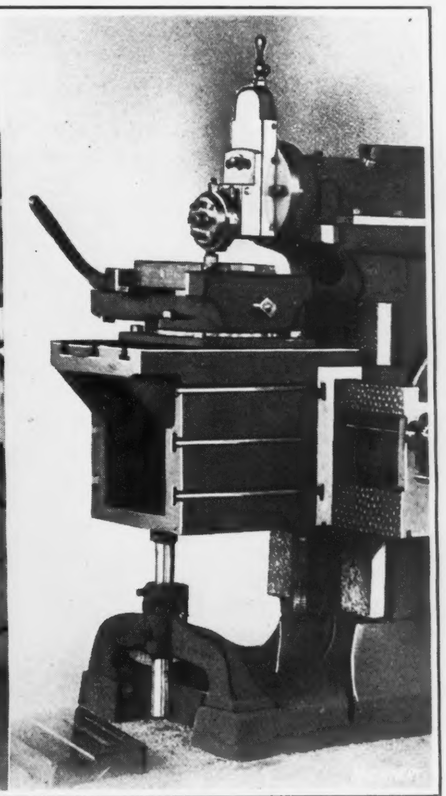


Fig. 5. Second Operation on the Part shown in Fig. 4

indexing so that the cylinder can be turned to the four positions necessary for machining both the ends and the sides of the work. The tools are held in a turret toolpost which has four positions to accommodate tools for four different operations. The cylinders are strapped to the top of the swivel plate of the fixture, so that either one of the two ends or either of the sides can be brought into position for shaping.

Fig. 6 shows an automobile crankcase, which was also formerly machined on a milling machine. The job required the use of milling cutters 10 inches in diameter with inserted high-speed steel blades. It was found that this

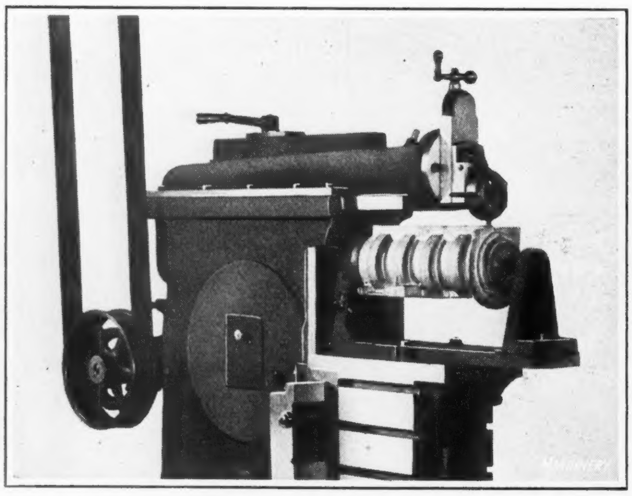


Fig. 6. Set-up for machining an Automobile Crankcase

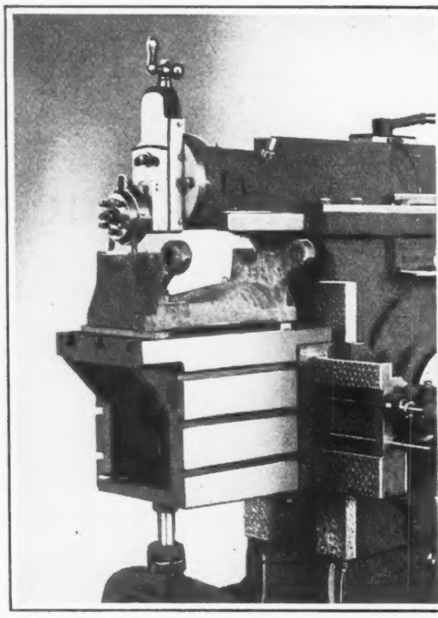


Fig. 7. First Operation on a Lathe Headstock

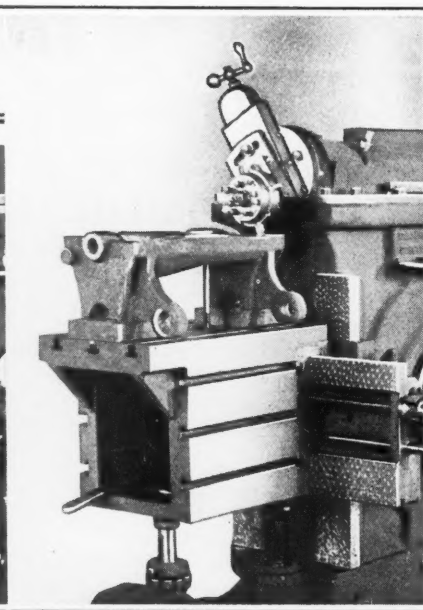


Fig. 8. Second Operation on the Headstock

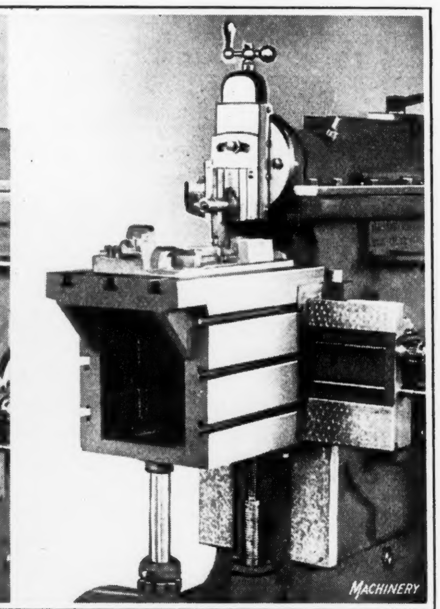


Fig. 9. Trimming Bosses on Lathe Apron

work could be done on a shaper in the same time as on a milling machine, with a saving in the first cost of tooling equipment. Furthermore, the shaper produced a straight but somewhat serrated surface which accommodated the gasket in a more satisfactory manner than the milled surface, which was wavy on account of the rotary motion of the cutter. A turret toolpost is used in this case also, and it carries one roughing and one finishing cutter. The crankcase is machined on three sides, and the fixture can be indexed to turn the work around 90 and 180 degrees. It is clamped tightly in the fixture for the performance of the shaping operation.

Some time ago the Smith & Mills Co. had occasion to machine parts for lathes, and it was found that by rigging up shapers for planing most of the flat surfaces, the work could be done profitably at a low cost as regards both the machine tool equipment and the tools, as well as at a minimum cost for power. In the particular case under consideration, an advantage was gained by being able to machine a few parts quickly so that subsequent operations and the assembling work could be started. If, on the other hand, machine tools requiring an expensive equipment for planing a large number of these parts at a time had been used, it would have been necessary to wait longer before the subsequent operations could have been started, and while the total time consumed for each operation might have been less, the entire time consumed before some of the machines were completed would have been greater.

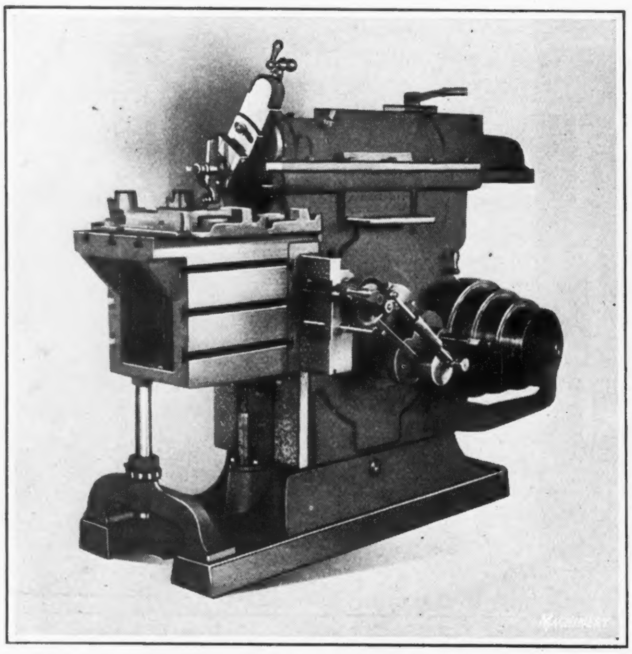


Fig. 10. Shaping out the Slot for the Split Nut on a Lathe Apron

Fig. 3 shows the top casting of the lathe tailstock being shaped on its bottom surface The casting is held in a vise and set with a surface gage, so as to insure that the hole will clean up in a subsequent boring operation, when this surface is used for locating purposes. Fig. 4 shows the lower casting of the tailstock being finished on the bottom, while Fig. 5 shows the same casting being shaped on the top. The turret toolpost is used in each instance, and is equipped with both roughing and finishing tools.

Fig. 7 shows the headstock casting mounted on the table of the shaper for the first operation. The casting is held to the table by a bolt passing through the cored hole in the center. Fig. 8 shows the

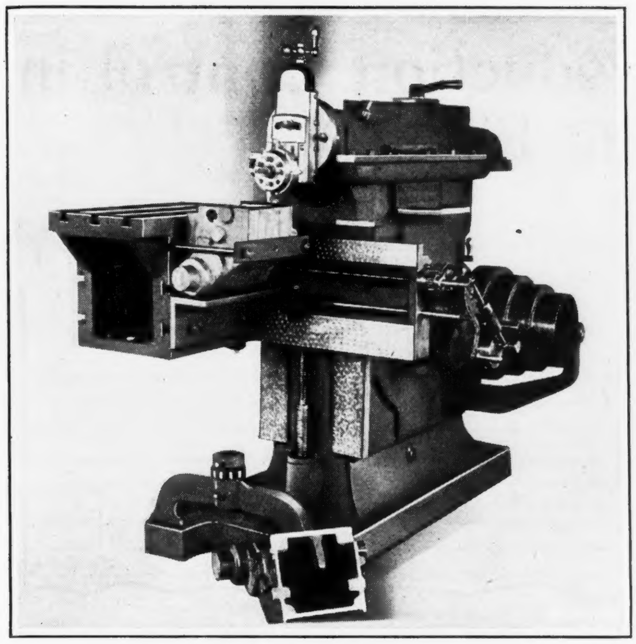


Fig. 11. Shaper equipped for machining a Lathe Feed-box

second operation—shaping off the bottom of the headstock. For this operation the work is located on setting blocks, as shown, which fit the surfaces shaped in the first operation. There is an angular way on one side and a flat surface on the other. The toolpost turret holds four tools, one for roughing and one for finishing the flat way, and one for roughing and one for finishing the angular way.

The first operation on the lathe apron is to shape off the top side and each edge. This operation is not illustrated. Fig. 9 shows the second operation, in which all the bosses are trimmed off on the inner side of the apron to an equal height, and Fig. 10 shows the shaping out of the slot for the split nut. At the end of these three shaping operations finished planed aprons were ready for further operations, such as drilling or vise work, and it was not necessary to wait until an entire lot had been finished in a multiple fixture on a planer before the work could be proceeded with.

Fig. 11 shows the lathe feed-box which was easily set up on the shaper with the use of a simple angle-plate and a strap with two bolts. In this operation the tongue and flat surfaces on the side of the feed-box by which it is attached to the lathe were machined. Four tools are used in the turret toolpost, two for roughing and two for finishing.

* * *

SHOULD FOREMEN DO DETAIL WORK?

By F. H. SWEET

The writer has known foremen who would set up every job, who would go to the tool-room and get all the tools and who would go out of their way to do various odd jobs, and yet their departments would not be efficient. They would spend so much time getting a job started right that they would have no time to superintend the work. They had no time to go over their orders, but would pick them out haphazardly or they would be picked out for them of necessity. They had no time to plan their work, to judge their men, or to watch their product, yet they would work themselves into nervous exhaustion and fail in health.

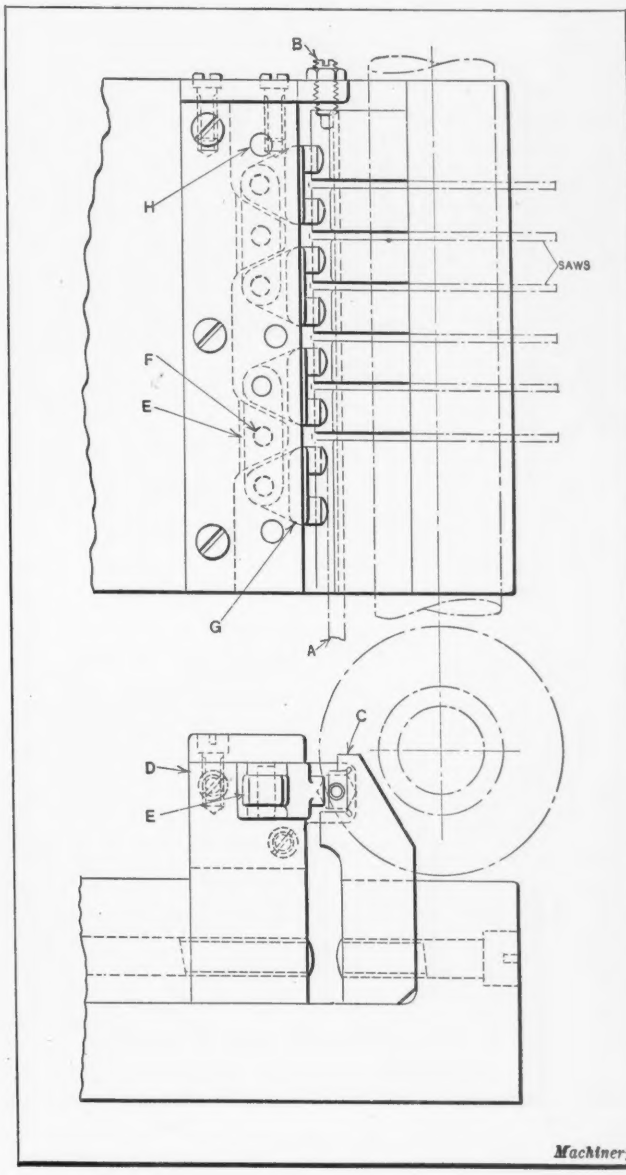
They were too busy looking after details to keep in sight the larger and more important things. They were so occupied that they had no time for conferences or interviews. They fooled themselves into thinking that the details they were doing could not possibly be done by anyone else. "One of the hardest things I have had to learn, is when to cease doing a detail and delegate it to someone," said one manager. This is especially difficult when it involves things that one can do very well, or things that one likes to do.

FIXTURE FOR MULTIPLE CUTTING OFF

By D. A. NEVIN

In the manufacture of firearms, typewriters, adding machines, and various classes of light machinery, there are many small parts that must be made from pieces sawed off from flat bar stock, because the thickness is too great to permit blanking them from flat sheet metal. In many cases the material is hard steel, which makes it difficult to obtain satisfactory results by cutting off in an automatic screw machine. For this reason these parts are often cut off in a milling machine, using a standard manufacturing vise to hold the stock. The illustration shows a pair of special vise jaws which were designed for use in sawing off six parts simultaneously, by employing six gang saws mounted on a milling machine spindle. The stock was 3/8-inch by 1/4-inch hard steel and is shown by dot-and-dash lines at *A*. The work is located against an adjustable stop-screw *B*, which is secured by a lock-nut. The saws are 1/16 inch thick.

The stock is supported by the rigid jaw *C* and clamped by the movable jaw *D* fitted with compound equalizers which provide for clamping all parts rigidly in place, thus allowing a maximum feed of the saws. The equalizing parts consist of the links *E* retained in the slotted jaw *D* by the pins *F* and carrying on each end the equalizing clamps *G*. Three pins *H* are provided to prevent the equalizing clamps from getting out of position. The parts are cut to a length of 0.494 inch plus or minus 0.0002 inch, and the jaws are mounted in a No. 3 Brown & Sharpe vise.



Vise Jaws for Multiple Cutting-off Operations

Cost Recording and Production Control in Drop-forging Plants

By H. F. OSLER

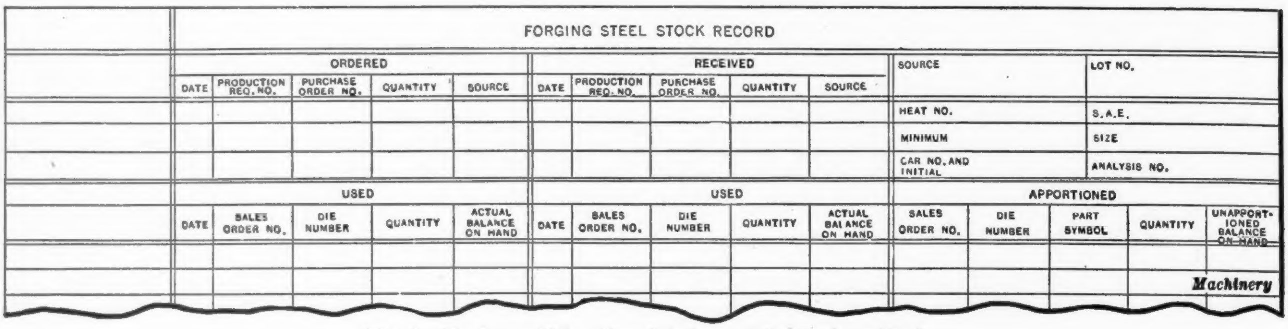
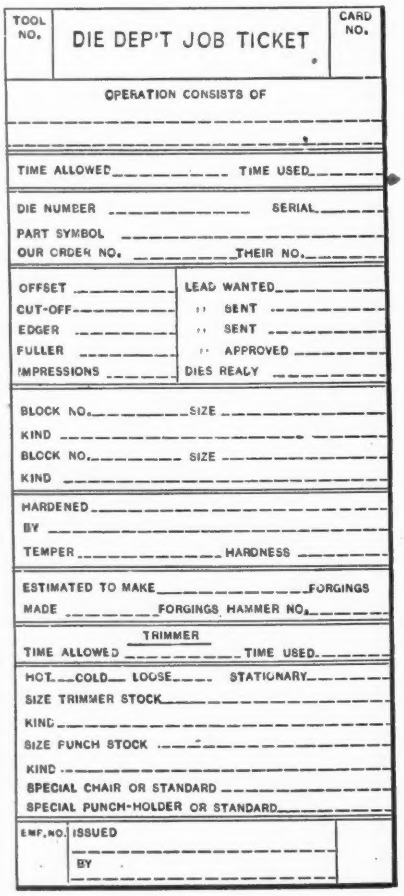

FORGING STEEL STOCK RECORD
ORDERED: DATE, PRODUCTION REQ. NO., PURCHASE ORDER NO., QUANTITY, SOURCE
RECEIVED: DATE, PRODUCTION REQ. NO., PURCHASE ORDER NO., QUANTITY, SOURCE
SOURCE, LOT NO., HEAT NO., S.A.E., MINIMUM, SIZE, CAR NO. AND INITIAL, ANALYSIS NO.
USED: DATE, SALES ORDER NO., DIE NUMBER, QUANTITY, ACTUAL BALANCE ON HAND
USED: DATE, SALES ORDER NO., DIE NUMBER, QUANTITY, ACTUAL BALANCE ON HAND
APPORTIONED: SALES ORDER NO., DIE NUMBER, PART SYMBOL, QUANTITY, UNAPPORTIONED BALANCE ON HAND
Machinery

Fig. 4. Sheet on which a Record is kept of the Stock on Hand

In the first installment of this article, published in June MACHINERY, the general need for more efficient cost-recording systems was emphasized, and some of the difficulties encountered in developing cost-recording systems in drop-forging plants were dealt with. Following this consideration of the cost-recording problem, an outline of a system of management which has proved very satisfactory in two large drop-forging plants was given. In the present installment the actual operation of the system will be described in detail.

In order to make clear the operation of the system, the progress of an order will be followed from the time that it is received by the sales department until the finished forgings are shipped. When an order is received by the sales department a set of sales orders is immediately made out on blank forms like that shown in Fig. 7. This order gives all the information available that will be of assistance to the executives who are responsible for the proper execution of the work. It will be noted that all items required in figuring costs are included on this order slip, so that there should be no cause for error or delay in obtaining the costs. A copy of this order is sent to the cost, the billing, and the production departments.

When the sales order is received by


TOOL NO. DIE DEP'T JOB TICKET CARD NO.
OPERATION CONSISTS OF
TIME ALLOWED TIME USED
DIE NUMBER SERIAL
PART SYMBOL
OUR ORDER NO. THEIR NO.
OFFSET LEAD WANTED
CUT-OFF " SENT
EDGER " SENT
FULLER " APPROVED
IMPRESSIONS DIES READY
BLOCK NO. SIZE
KIND
BLOCK NO. SIZE
KIND
HARDENED
BY
TEMPER HARDNESS
ESTIMATED TO MAKE FORGINGS
MADE FORGINGS HAMMER NO.
TRIMMER
TIME ALLOWED TIME USED
HOT COLD LOOSE STATIONARY
SIZE TRIMMER STOCK
KIND
SIZE PUNCH STOCK
KIND
SPECIAL CHAIR OR STANDARD
SPECIAL PUNCH-HOLDER OR STANDARD
EMP. NO. ISSUED
BY

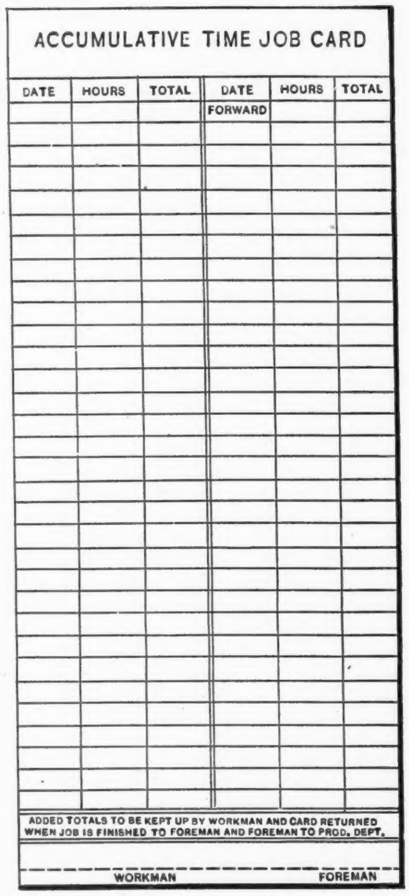
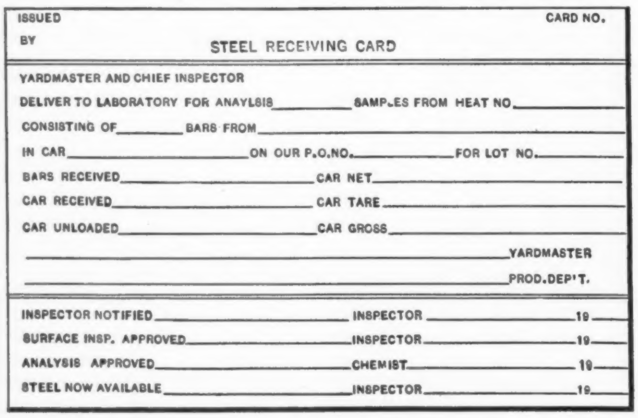

ACCUMULATIVE TIME JOB CARD
DATE HOURS TOTAL DATE HOURS TOTAL
FORWARD
ADDED TOTALS TO BE KEPT UP BY WORKMAN AND CARD RETURNED WHEN JOB IS FINISHED TO FOREMAN AND FOREMAN TO PROD. DEPT.
WORKMAN FOREMAN

Fig. 5. Front and Back of Die Order Blank


ISSUED
BY
STEEL RECEIVING CARD
CARD NO.
YARDMASTER AND CHIEF INSPECTOR
DELIVER TO LABORATORY FOR ANAYLSIS SAMPLES FROM HEAT NO.
CONSISTING OF BARS FROM
IN CAR ON OUR P.O.NO. FOR LOT NO.
BARS RECEIVED CAR NET
CAR RECEIVED CAR TARE
CAR UNLOADED CAR GROSS
YARDMASTER
PROD.DEP'T.
INSPECTOR NOTIFIED INSPECTOR 19
SURFACE INSP. APPROVED INSPECTOR 19
ANALYSIS APPROVED CHEMIST 19
STEEL NOW AVAILABLE INSPECTOR 19

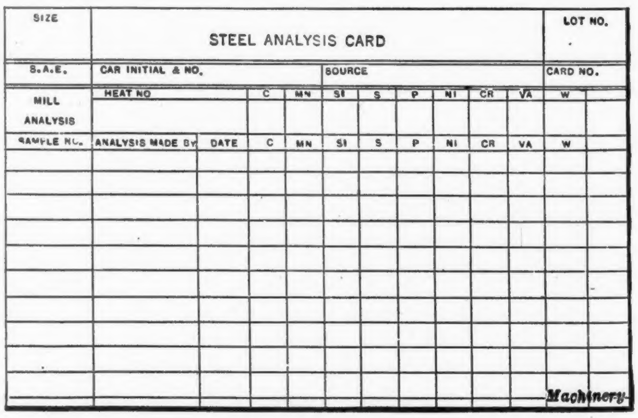

SIZE
STEEL ANALYSIS CARD
LOT NO.
S.A.E. CAR INITIAL & NO. SOURCE CARD NO.
MILL ANALYSIS HEAT NO C MN SI S P NI CR VA W
SAMPLE NO. ANALYSIS MADE BY DATE C MN SI S P NI CR VA W
Machinery

Fig. 6. Front and Back of Steel Receiving and Analysis Recording Card

the production department, the information board is consulted to determine the condition of the dies and trimmers. If a new die is required, an order is made out on a form, the front and back of which are shown in Fig. 5. If the die simply requires repairing, an order is made out on a form provided for that purpose. These orders give all the information required, including the time allowed. Copies of these orders go to the die-room and cost department.

Ordering Materials

From the steel or stock record, made out on the form shown in Fig. 4, it is next ascertained if the steel required in making the forgings is available. If the stock is on hand, the allotment of the required amount is noted on the record, and a requisition is sent to the purchasing department, calling for an amount of steel sufficient to replace the allotment. This requisition is made out on the form shown in Fig. 8. If the record sheet shows that the steel is not available, the same procedure is followed so that all the records will be complete and up-to-date. Complete information in regard to the quality and kind of steel needed is placed on the requisition slip.

When the purchasing department orders the steel, a copy of the order is sent to the production department, which then follows the order until shipment is made. All information regarding the ordering of steel, the condition of dies, etc., is posted on the information board by inserting tacks of the proper shape, color, or color combination. For instance, referring to Fig. 2 in the first installment of this article, the tack at *d*, which is black with a white cross in the center, indicates that the steel is available and an allotment has been made. A triangular green tack *e* shows that the trimmers have been inspected and found ready for use. A square red tack at *f* shows that the lead cast of the forging has been approved, and a square green tack at *g* indicates that the dies are ready for use.

ISSUED .... DROP FORGE DEPARTMENT PART SYMBOL ....
BY .... **SALES ORDER** DIE NUMBER ....
FORM PS. 11-20-1M ORDER No. ....

Part Name .... Quantity ....
Customers Order No. .... Date ....
Customer ....
Address ....
Ship to ....
Address ....
Routing ....
Use Hammer No. .... Fires .... Helpers ....
Size Material .... Cut .... For .... Forgings ....
Gross Weight Ea. .... Net Weight Ea. .... Heat Treat ....
Specifications S.A.E. .... C .... MN .... SI .... S .... P .... NI .... CR .... VA ....
Dies Billed at .... F.O.B. ....
Terms ....
Price Each .... F.O.B. ....
Terms ....
Estimate No. ....
Average No. Pcs. to be Forged Per .... Hr. Day ....
Average No. Pcs. to be Trimmed Per .... Hr. Day ....
Hours Allowed to Make Dies ....
Hours Allowed to Make Trimmers ....
Approved by .... Date ....

Operation Numbers for Dies ....
Operation Numbers for Trimmers ....
Operation Numbers for Forgings ....

CUSTOMERS SCHEDULE and REMARKS

Fig. 7. Sales Order Blank, which is filled out by the Sales Department

PRODUCTION DEP'T REQUISITION ON PURCHASING DEP'T

PLEASE PURCHASE FOR DROP-FORGE DIVISION THE FOLLOWING STEEL

POUNDS	SIZE	S.A.E. SPECIFICATION	BAR LENGTHS	C	MN	SI	S	P	NI	CR	VA

TO BE DELIVERED AS FOLLOWS:

FOR SALES ORDER NO.	PART SYMBOL	DIE NUMBER	LOT NO.	PURCHASE ORDER NO.	DATE	SOURCE

APPROVED BY .... REQUISITIONER ....
DATE .... DATE ....

Fig. 8. Requisition sent to the Purchasing Department

The system for receiving and inspecting the stock is as outlined in the following: At the time an order of steel is received, a receiving and analysis card, the front and back of which are shown in Fig. 6, is made out in the production department. When a shipping manifest of steel is received by the production department, a lot number is assigned to every size according to its specifications. If more than one heat of each size is included in the order, a letter is added to the lot number, and in unloading, care is taken to see that each size and lot are placed in separate piles and properly marked. Two copies of the receiving and analysis card are sent to the yardmaster, one copy to the inspection department, and one to the laboratory. When the car carrying the steel arrives, the yardmaster notifies the inspection department by sending it one of the copies of the steel receiving and analysis card, after which he weighs the car.

The inspection department makes a surface inspection of the steel, and takes one sample, by lot numbers, from each ten bars for analysis. Then there is placed on each lot the inspectors "hold card" on which is printed in large type "Hold—do not use this material. It has not been passed by the inspection department." The samples are next sent with the yardmaster's notification slip to the laboratory. The steel is inspected during the unloading operation, at the end of which the car is weighed light, and the weight entered on the receiving and analysis card, as shown in Fig. 6.

When the steel analysis has been completed at the laboratory, the inspection

FORM P7 11-20 25 BOOKS

LEAD APPROVAL

To Die Foreman .... 19 ....

....

Have Approved Lead Cast For Die No. .... Serial No. ....
Part Symbol .... Part ....
Have Die and Trimmer Ready For Production On .... 19 ....
Hammer No. .... Press No. ....

....
Production Dept.

Dies Were Ready For Production On .... 19 ....
Trimmers Were Ready For Production On .... 19 ....

....
Foreman

Billing Price of Dies $ ....
Customer ....
Dies Billed By .... 19 ....

Fig. 9. Lead Approval Slip made out when the Customer approves the Lead Cast

analysis slip is sent from that department to the inspection department and the "hold card" is removed from the steel. This steel is then available, and the inspection analysis slip is sent to the production department. At the time the car is unloaded, the yardmaster sends his second copy of the receiving analysis slip to the purchasing department, as a receiving slip. Each step in the receiving, testing, and storing of the steel is recorded on the information board.

Approval of Lead Cast

As soon as the lead cast is ready for the customer's approval, the die-room forwards it to the inspection department. After it has been approved by the inspectors, it is sent to the production department, and from there to the customer. When the customer approves the lead cast, the production department makes out a set of lead cast approval slips on the form Fig. 9. Three copies of this approval slip are sent to the die-room and one to the billing department. When the dies and trimmers are ready for use, the die-room forwards one copy to the production department and one to the cost department. This progress is also posted on the information board.

Delivery of Steel at Forging Hammer

About five hours before a hammer completes the job on which it is at work, the production department makes out a set of release slips of the form shown in Fig. 10. Copies of this slip are sent to the die-room foreman, hammer-shop foreman, steel-room foreman, timekeeper, and cost department. When the steel-room foreman receives his copy, he immediately prepares to transfer the steel from the store-room to the hammer, so that no delay will occur.

FORM P6 11-20 25 BOOKS

DIE and TRIMMER RELEASE

19

TO HAMMER / TRIM SHOP FOREMAN

Die No. Seria Symbol Part

Is Released To HAMMER NO. / PRESS NO. At M 19

To FORGE / TRIM Pieces on Order No.

Lead Cast Was Approved By Customer 19

The Rate On This Part Will Be

On This Work There Will Be Allowed Fires Helpers

Size Steel Will Be Cut To Make Forgings

Operation Numbers Are

Steel Lot No.

Production Department

Taken Out M 19 Account Of

This Die Must Be Repaired Resunk Or Will Be Able To Forge Pcs. More

This Trimmer Must Be Repaired A New One Made Or Will Trim Pcs. More

Foreman

Fig. 10. Die and Trimmer Release Order

DROP-FORGE DIVISION

INSPECTOR'S DAILY INDIVIDUAL HAMMER REPORT

HAMMER NO.

FORGER NO. DATE

PART NO. DIE NO.

RAW MATERIAL TODAY

AT START SIZE PCS. WEIGHT

DELIVERED SIZE PCS. WEIGHT

AT FINISH SIZE PCS. WEIGHT

USED SIZE PCS. WEIGHT

GROSS WEIGHT OF FORGINGS MADE TODAY

FORGINGS MADE TODAY

HEAT NO.	GOOD	REJECTS	CAUSE OF REJECTION
	FORGINGS REPAIRED TODAY		

PRODUCTIVE HOURS NON-PRODUCTIVE HOURS

REASON FOR DOWN TIME

SIGNED BY INSPECTOR

DEFECTIVE MATERIAL

DATE	NO.
PART SYMBOL	DIE NO. AND SERIAL
MADE ON ORDER NO.	REPAIR NUMBER
NUMBER PCS. DEFECTIVE	NO. PCS. SAVED
LAST OPERATION	NEXT OPERATION
NATURE OF DEFECT	
DISPOSITION	
INSPECTOR REJECTING	
CHARGE COST OF MAKING GOOD TO	
INSPECTOR ACCEPTING	

DATE	NO.
PART SYMBOL	DIE NO. AND SERIAL
MADE ON ORDER NO.	REPAIR NUMBER
NUMBER PCS. DEFECTIVE	
NATURE OF DEFECT	
LAST OPERATION	
DISPOSITION	
INSPECTOR REJECTING	
NEXT OPERATION	
CHARGE COST OF MAKING GOOD TO	

DEFECTIVE MATERIAL

MOVE ORDER NO.

DATE SHIFT

MOVE FROM TO

PCS. PART NO.

DIE NO SERIAL S.O.NO.

OPERATIONS TO PERFORM IN MAKING THESE FORGINGS

COMPLETED OPERATIONS

NEXT OPERATION

PRODUCTION DEP'T

WHEN MOVE HAS BEEN MADE, SIGN AND RETURN TO PROD. DEPT.

DATE MOVER

MOVE RECEIPT NO.

DATE SHIFT

RECEIVED FROM

PCS. PART NO.

DIE NO. SERIAL S.O.NO.

TO PERFORM OPERATION

LAST OPERATION PERFORMED

NEXT OPERATION TO PERFORM

COUNTER FOREMAN

WHEN RECEIVED CHECK SIGN AND RETURN TO PROD. DEPT.

Fig. 11. (A) Individual Hammer Report (B) Defective Material Tag (C) Work Transfer Order Blank

FORM P6 11-20-25 BOOKS NO.

RAW MATERIAL DELIVERY NOTICE

From Lot No. Heat

I Delivered Pcs. of

Cut Lg. Which Will Make Pcs. Ea.

For Die No. Serial

Part Symbol

To Hammer No. At M 19

Actual Weight in Pounds

19

Yardmaster

19

Production Dept.

Weight @ per lb.

19

Cost Dept.

Pieces at Start Today

Pieces Delivered Today

Total Pieces at Hammer

Gross Forgings Made

Pieces Left at Close

Forge Order No.

REMARKS

Fig. 12. Raw Material Delivery Notice

FORM 11P. 11-20 10 BOOKS NO.

RAW MATERIAL TRANSFER NOTICE

From Hammer No. At M 19

I Transfered Pcs. of

Lot No. Heat No.

Cut Long. To Stock

Actual Weight in Pounds

For Die No. Part

Reason

Date

Yardmaster

Date

Production Dept.

Weight Lbs. @ $

Date

Cost Dept.

Forge Order No.

REMARKS

Fig. 13. Raw Material Transfer Notice

FORM P3. 11-20-2M

DROP FORGE DEPARTMENT

DAILY PRODUCTION REPORT

SHIFT.. DATE ....

Hammer Number	Die No.	Die Serial	Part Symbol	CUSTOMER	Emp. No.	PRODUCTION					Pieces Restruck	Pieces To Run	Next Die	Steel Lot No.	Prod. Hrs.	Fires	Helpers	Cause for Delay
						Gross	Net	Scrap	Welds	Restrikes								

Weight of steel used today
Weight of steel used to date
Weight of finished forgings today
Weight of finished forgings to date
Weight of rejections today
Weight of rejections to date
Weight of scrap today
Weight of scrap to date
Percent actual running time
No. employees today **No. absent**

Weight shipped today
Weight shipped to date
Weight shipped last period
Weight shipped to date last year
Value forgings produced today
Value forgings produced to date
Value forgings produced to date last period
Value forgings produced to date last year
Payroll today **Hours today**
Payroll to date

Fig. 14. Daily Production Report Sheet made out from the Individual Hammer Reports

When the steel-room foreman delivers the steel to the hammer he makes out a steel delivery slip on the form shown in Fig. 12, and if at any time he removes steel from the hammer he makes out a transfer slip on the form shown in Fig. 13. At the close of each shift, one copy each of these slips is handed to the production and cost departments. The steel-room foreman has the amount of steel at the hammers checked at the beginning and end of each shift, and the amounts recorded on the slips. The production department then checks the amounts on these slips against the forgings made, and deducts from or adds to the steel record the amounts shown on these slips.

As work on the order progresses, the floor inspector makes out at the end of each shift an individual hammer report on the form shown at *A* in Fig. 11. These reports are sent to the production department at the end of each shift. As these slips give the amount of steel for each hammer at the beginning and close of each shift, the number of net rejects and scrap forgings made, the number of productive hours spent, and the reasons for any delay or

FORM P1. 11-20-1M

PART NAME..........................
HAMMER..........................
ESTIMATE NO..........................

DROP FORGE DEPARTMENT

PRODUCTION RECORD

CUSTOMER

....

SHEET ◯ OF ◯

CUSTOMERS REQUIREMENTS	HAMMER NO.	DATE	SHIFT	GROSS	TOTAL GROSS	FINISHED	TOTAL FINISHED	BALANCE TO RUN	BLOCKED	RESTRUCK	TRIMMED	SHOP REJECTS		TRIM		FINAL INSPECTION		RETURNS BY CUSTOMER		DATE	PACKING SLIP NO.	QUANTITY	TOTAL SHIPMENT	BALANCE TO SHIP	VIA	ORDER NO. ....
PRODUCTION																				SHIPMENTS						
												Scrap	Repair	Scrap	Repair	Scrap	Repair	Scrap	Repair							
OPERATION NUMBERS																										DIE NO Part Symbol Customers Order No. Date Cust. Order Date Entered Size Material Steel Specifications Length to Cut Steel Length Makes Pcs. Gross Wgt. ea. Net Wgt. ea. Quantity On Order Quantity Steel Needed Quantity Steel in Stock Steel Lot No. Quantity Steel Ord. Steel Mill Steel Order No. Steel Promised Average Per Day Ship Via Lead Cast Sent Lead Cast Approved Fires Helpers Heat Treat

Fig. 15. Production Record Sheet filled out from Daily Production Report

FORM PS. 11-20-28 BOOKS

DIE AND TRIMMER REPORT

19

TO PRODUCTION DEPARTMENT—I have this day made an inspection of Die and Trimmer

Returned from Hammer No. Press No. and find same is

Good to Forge Pcs. More. Trim Pcs. More. Will have to be

Resunk-Repaired and will require approx. Hrs. I have had same

placed in Rack No. Bin No. This Die Made Pcs. On

Hammers This Trimmer Trimmed

Pcs. On Press No. The Condition Of This Die Was

Caused By

Die No. Serial Part Symbol

Foreman Die Room

Resink Order Number Issued 19

Repair Order Number Issued 19

Production Department

Fig. 16. Die and Trimmer Report Blank

failure to meet the production schedule, it is an easy matter for the production department to record all progress on the production board.

From these slips and the shipping report, the production department makes out the daily production report on the form shown in Fig. 14. The production record is made out from this production report on the form shown in Fig. 15. If the floor inspectors find defective forgings that can be repaired, they place a defective ticket such as shown at *B*, Fig. 11, on them, and send the stub or lower part of the ticket to the production department with the individual hammer reports. When the pieces are repaired and passed by the inspector, the remainder of the ticket is turned in to the production department also. Whenever forgings are moved from one place to another for different operations, a "move ticket," such as shown at *C*, is made out.

FORM PS. 11-20-1000 SET

DROP FORGE DEPARTMENT

No. A- 475

Ship to 19

At Order Number 19

Charge to Customers Order No.

At Total Quantity on Order

Ship Via. Ship Collect—Prepaid

Quantity Due	Quantity Shipped	Part Symbol	Die Number	Serial	Part Name	Weight	Price	Amount
					Containers			

Claims For Shortage Must Be Made Within 5 Days After Receipt Of Goods, No Goods Can Be Returned Until Has Been Notified and Shipping Instructions Given.

Shipment No. For Year Shipment No. of This Order

Date Shipped Issued By Date

Routing Shipped By Date

Collect—Prepaid Prod. Dept. Date

Bill Lading No. Priced By Date

Car Initial and No. Checked By Date

Form of Shipment—Loose—Bags—Boxes—Bbls. and Number Invoiced No. Date

Received By Date Invoiced By Date

Audited By Date

Fig. 17. Shipping Order Blank

When a job is completed, the dies are removed from the hammer and sent at once to the die-room. The hammer-shop foreman fills in the remainder of the release order and sends it to the production department. Upon receipt of the dies and trimmers, the die foreman makes out an inspection report on the form shown in Fig. 16, and sends it to the production department. This information is recorded on the information board.

Shipping Statements

When a hammer release slip is made out by the production department, a set of shipping statements are made out on the form shown in Fig. 17. One copy of these statements is kept as a tracer, one forwarded to the billing department, also as a tracer, and four copies are sent to the shipping department. Two of the copies are sent to the shipping department when the goods are shipped to the customer, one to be signed by the customer and returned, and one to be retained by him. One copy goes directly to the cost department and the other to the production department. From the copy received by the production department is posted the production record, after which this copy is sent to the billing department from which it is sent to the cost department. At the end of each day the shipping department sends one copy each of the daily shipment reports, Fig. 18, to the production, billing, and cost departments.

When shipping instructions are given to a customer for the return of goods, the production department makes out a set of receiving inspection reports on the form shown in Fig. 19, and sends them to the receiving department. When the forgings arrive, this set of reports is sent to the inspection department, where the goods are inspected. Three copies of the inspection report are then sent to the production department, which, in turn, forwards one copy to the billing department and one to the cost department. The inspection department attaches a ticket to these forgings like the one used for shop rejects, and from then on they are handled in the same manner as shop rejects, except that they bear a repair order number instead of a sales order number.

A system such as the one described in the two installments of this article makes it possible for an effective control to be exercised over production in a drop-forging plant and for an accurate record to be kept of the costs of production, which, of course, are vital requirements in any manufacturing organization. The various forms illustrated will be of suggestive value to other plants engaged on the same or similar classes of work, who wish to install a system that will enable them to determine definitely whether their work is being done at the lowest possible cost. These forms would, of course, be modified to suit the conditions peculiar to different plants.

* * *

According to *Safety Engineering*, 75,500 lives were lost and 2,000,000 people seriously injured in the United States by accidents last year. Of this number 11,000 persons were killed in automobile accidents alone.

FORM P-10. 4-21-5C

DROP FORGE DEPARTMENT

DAILY REPORT OF SHIPMENTS

DATE 19

Yours Shipment No.	Packing Slip Number	Co. Order No.	Part Symbol	Die Number	CUSTOMER	Number of Pieces	Weight	Shipped Via.
TOTALS								

Fig. 18. Daily Report of Shipments

HELPING EMPLOYES TO SAVE

At the plant of the Dodge Mfg. Co. in Mishawaka, Ind., it was realized some years ago that the failure of employes to save any part of their wages was preventing them from getting the success and satisfaction out of life that their work and efforts entitled them to. Not that conditions were any worse in this factory than elsewhere; it was simply that the management of this concern noted an obstacle in the path of men in the company's employ. The fact was borne home with unusual strength during the early part of 1915 when industrial wages were reaching a new high level.

At that time C. E. Lukenbach, employment manager of the Dodge Mfg. Co., came before the directors of the firm with a plan designed to instruct employes in the practice of thrift. He claimed that factory workers could be taught to save a definite amount of their weekly wages, and offered to interview the men in the factory personally and get them to join a Thrift Club. According to the plan, no inducement was to be offered beyond that of calling attention to the failing common to all classes of men of spending their entire income.

The preliminary canvass for members of the Dodge Thrift Club was started in May, 1915, and during the first week pledges of weekly deposits were received amounting to $79.50. Every man had to be "sold" personally on this proposition; but the results are shown by the fact that from May, 1915, to January, 1916—a period of seven months—the deposits had increased to $6000, and on January 1, 1917, this amount had grown to $20,000. From that time on the progress of this Thrift Club has been almost phenomenal. During 1919 the amount deposited was $82,000, and for 1920 the deposits totaled $130,000.

In order to bring the benefits of the Thrift Club within the reach of all factory employes, it was decided to accept deposits in amounts of 25 cents a week up, in any multiple of the minimum deposit. All those who join the Thrift Club are expected to continue making deposits for at least thirteen weeks, and after twenty-six weeks, interest is paid on the average balance at the rate of 5 per cent. Every depositor is urged to start low and to increase his rate of deposit as he is able to. At the present time deposits range from 25 cents up to $30 a week. There are three men who deposit their entire wages and then take advantage of the checking privilege which goes with membership in the club. A depositor may withdraw any sum on such checks up to the amount of his entire deposit. To do so he goes to the office and fills in a special withdrawal notice. This notice is sent to the treasurer's office, and a bank check is drawn against the account of the Thrift Club in favor of the member who wishes a check for the payment of some current bill.

The measure of success of this Thrift Club is best shown by the fact that many men who formerly spent every cent they earned have now formed a habit of setting aside something for the proverbial "rainy day." At the time the club was started many of the men had been in debt for years—not, perhaps, for a large amount, but nevertheless in debt.

To show the results that the Thrift Club is accomplishing, it will be of interest to cite one or two specific examples. Not long ago a man came to the office of the employment manager and asked for a blank on which he ordered the withdrawal of $21 from his account in the Thrift Club. That man's wife had been sick and the rent money had been used to pay the doctor. It certainly made things easier to have a surplus for the landlord on the first of the month. Another man who had been most difficult to get into the Thrift Club accumulated a surplus of $86, and then used the money to clear up a number of debts; he stated that during fourteen years of married life he had never been out of debt.

RECEIVING INSPECTION REPORT						DATE RECEIVED		NUMBER
FROM								
VIA	CAR NO. & INITIAL		PRO. NO.		EXPRESS CHARGES	FREIGHT CHARGES	INSPECTOR	DIE NUMBER
CONTAINED IN	TOTAL QUANTITY RECEIVED	KIND OF UNIT	NET WEIGHT	GROSS WEIGHT	QUANTITY REJECTED	WEIGHT OF REJECTIONS	QUANTITY ACCEPTED	SERIAL NO.
OUR ORDER NO.								
THEIR ORDER NO.	PART NAME					CUSTOMER		
RECEIVING CLERK	QUANTITY REJECTED	PRICE EA	TOTAL		CREDITED CUSTOMER	BY	RETURNED	PACK. SLIP NO.
CAUSES FOR REJECTION								
APPROVED								
DISPOSITION								
APPROVED								

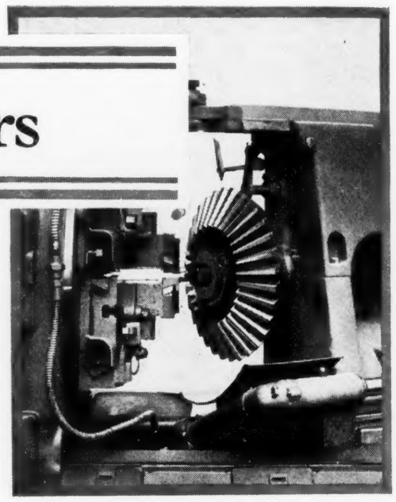
Machinery

Fig. 19. Receiving and Inspection Report Blank for Goods that have been returned by the Customer

Insurance Privileges of the Mutual Relief Association

In addition to the Thrift Club, the Dodge Mutual Relief Association maintains a fund from which payments are made to the members for time lost through sickness and also to the beneficiary of the insured upon death. There are six different plans of insurance to which subscription may be made, and these carry various benefits for disability or death. At present there are 750 members of the office and shop force who are carrying this protection, and as it is obtained on the mutual basis, that is, without yielding any profit to stock-holders, the rate is very low.

Cutting Bevel Gears



Principles Governing Operation of Generating Planers and General Methods of Setting up and Adjusting Bilgram Machine for Cutting Bevel Gears—First Installment

By FRANKLIN D. JONES

CUTTING bevel gears is not so simple as cutting spur gears, because the teeth have a converging form. A correctly formed bevel gear tooth has the same sectional shape throughout its length but on a diminishing scale from the large to the small end. This accounts for the fact that a bevel gear cannot be cut properly by using a formed milling cutter which simply reproduces its shape, because if this cutter were of the exact curvature required at the large end of the tooth, it would not be correct for any other part, and the error would be considerable at the small end of the tooth. Consequently, accurate bevel gears are cut by a generating process, since that is the only way to give the tooth the proper curvature on a diminishing scale, the tooth tapering toward the apex of its pitch cone.

Principle of Generating Process as Applied to Bevel Gears

In connection with the cutting of spur gears by generating methods, it was explained that the straight-sided rack of involute gearing is represented either directly by the cutter used, or indirectly as when a circular form of cutter is generated from the rack. Now the relation between a rack and spur gear is similar to that of a crown gear to a bevel gear; thus the pitch surface of a rack and also of a crown gear coincides with a plane. The teeth of a crown gear are also straight sided like those of a rack, although of converging form, and the inclination of each side corresponds to the pressure angle. The cutting tools of bevel gear generators, therefore, represent the crown gear and when a bevel gear is being cut the tooth curves are derived by imparting to the work and to the cutting tool the same relative motion that would be obtained if the gear being cut were rotating in mesh with the crown gear. In addition to this generating motion, provision must be made in a practical design of machine for giving the tool or tools a reciprocating motion for cutting, and an indexing movement to the work in order to cut equally spaced teeth around the entire gear.

The generating motion on some machines is obtained by rolling the gear being cut, relative to the cutting tool (representing a crown gear tooth) just as though this gear were finished and rolling around a stationary crown gear. Thus all the generating motion is applied to the work; the cutting tool is simply given a reciprocating motion for planing. This method of generating is illustrated by the diagram Fig. 1. The gear to be cut, which is usually roughed out before finishing the teeth on a generator, is rolled about axis x of an imaginary crown gear while the planing tool is at work. One side of this tool or cutter is in the same position as the side of a crown gear tooth, and the point of the cutter moves along line x—y. The cutter forms one side of the tooth while the gear is slowly rolling from the position indicated by the full lines to the position shown by the dotted lines.

This rolling motion must be sufficient to roll the entire side of a tooth along the straight cutting edge of the tool. This straight cutting edge produces a smooth curved surface, because the rolling movement is very slight for each cutter stroke; hence, a number of strokes are required to finish the side of a tooth. Means must be provided to positively and accurately control this rolling motion of the gear. Suppose that the work-spindle carried at the outer end a master gear or a segment gear extending over a large enough arc to provide for all the rolling motion that is required; and assume that this master gear segment has the same pitch cone angle and pitch as the gear to be cut and is in mesh with a fixed crown gear segment. Then the rolling action can be properly controlled. The Bilgram machine, which is one type to be considered, operates on this general principle, although instead of actually using master and crown gear segments having teeth, a segment of the pitch cone with a smooth conical sur-

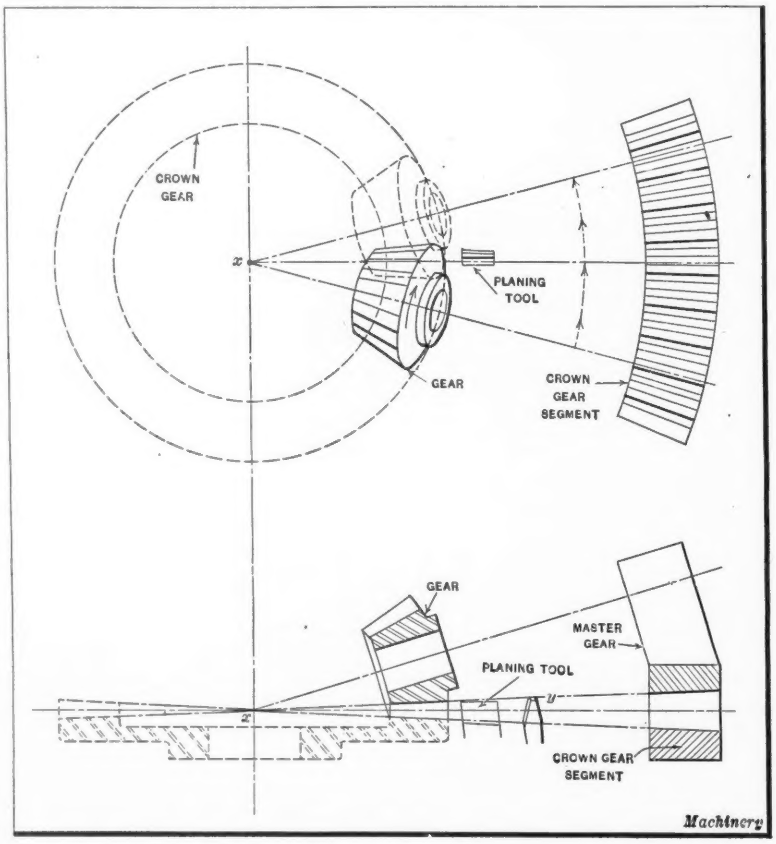


Fig. 1. Diagram illustrating Action of Bevel Gear Generator when all of the Generating Motion is applied to the Gear

face rolls on a flat surface as explained later. In the diagram Fig. 1, no provision is made for indexing the gear to present different teeth to the cutting tool. This part of the mechanism will be considered in connection with commercial types of machines.

Action when Generating Motion is Applied to Both Gear and Planing Tool

A common type of bevel gear generator is so designed that the generating action is applied to both the work and to the cutting tools. In this case the action is similar to that of a crown gear rotating in mesh with the gear being cut, each gear revolving about a fixed axis. Fig. 2 represents this generating motion in diagrammatic form. While each gear tooth is being planed, the gear turns part of a revolution about a fixed axis $x—x$, just as though the imaginary crown gear were turning with it. The planing tool also swings around with the gear as though it were one of the crown gear teeth. Only one tool is shown on the diagram to simplify it, although two are used on the Gleason machines which represent a commercial application of the generating motion illustrated by this diagram. Because of the converging form of the space between two teeth, it is impossible to cut more than one side at a time with a single tool or cutting edge, although it is not only feasible but desirable to use two tools which operate on both sides of a tooth.

On some machines the generating action indicated by Fig. 2 is controlled by a crown gear, which, as indicated by the diagram, swings with the toolslide, and is in mesh with a master gear segment connecting with the work-spindle. Such an arrangement causes the crown gear segment and the tools to move through an arc represented by the full and dotted lines, while at the same time the master gear rolls in mesh with the crown gear and causes the gear blank to turn in unison with the tools. Another method of regulating and controlling this generating motion is by using suitable combinations of change-gears instead of the crown and master gear segments. Thus, by selecting gearing of the proper ratio, the relative motion between the tools and work is the same as though a crown and master gear segment were employed.

Planing Bevel Gears on Bilgram Machines

The Bilgram bevel gear generator made by the Bilgram Machine Works, Philadelphia, Pa., operates on the principle illustrated by the diagram Fig. 1, of imparting to the gear to be cut, a rolling motion corresponding to the rotation of a finished gear rolling on a crown gear. This generating motion might be derived from a master gear rolling on a crown gear as previously explained, but in the practical application of this principle to the Bilgram machine, a segment of the pitch cone is used instead of a master gear, and as this segment rolls on a flat surface representing the pitch surface of the crown gear, the blank being cut receives the required generating motion.

The action of this machine and its adjustment for cutting bevel gears will be described in connection with Figs. 3 and 4. While these views are not of the same machine, they show the mechanism from opposite sides. The part of the machine to the right, as seen in Fig. 3, is the shaper or planing mechanism, and at the left of the gear being cut is the generating mechanism from which the rolling motion is derived. When the machine is at work, the tool is lifted to clear the blank during the return stroke, but it does not have a lateral feeding motion like the Bilgram spur and spiral gear generator. During each return stroke of the tool, the gear blank indexes to bring the following tooth space into the cutting position. In conjunction with this indexing movement the progressive rolling action of the gear occurs. The vertical axis of the imaginary crown gear about which the gear being cut rolls, is at the left of this gear, and the action of the gear is the same as though it were rolling on a crown gear having teeth on the under side.

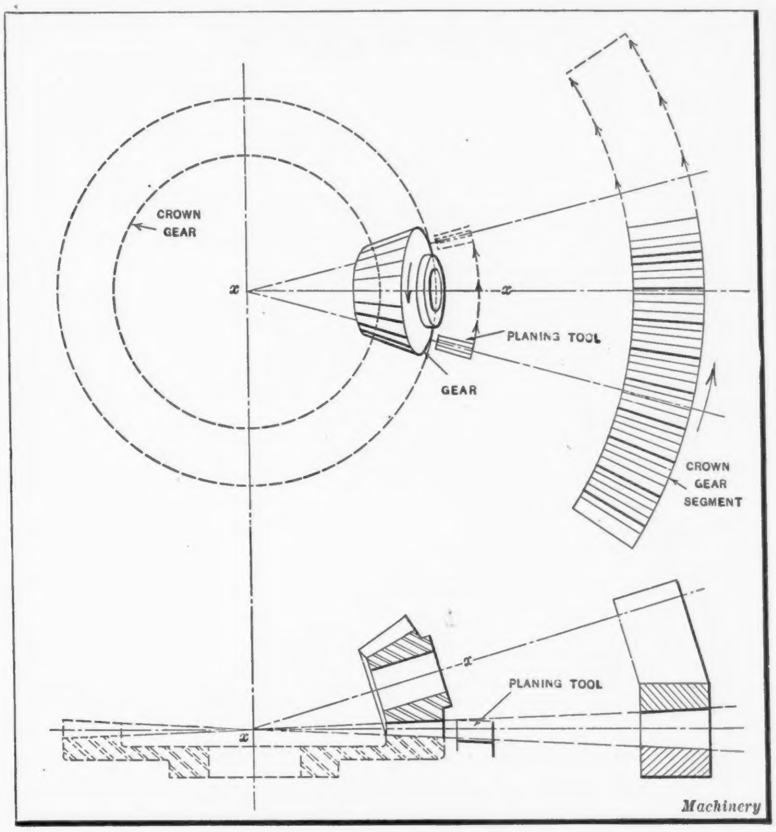


Fig. 2. Diagram representing Action when Generating Motion is applied to Both Gear and Tool

The planing tool (representing a crown gear tooth) takes successive cuts from tooth spaces around the entire gear as the latter is indexed after each cutting stroke; consequently, when rough-planing a gear from the solid blank, all of the teeth are roughed out while the gear is slowly rolled from the beginning to the end of its generating movement. When finishing a gear after roughing, all of the teeth are first finished on one side and then, after making a slight adjustment and inserting another tool, the remaining sides of the teeth are formed.

The cutting of gears directly from solid blanks is common practice in connection with jobbing work; if a quantity of duplicate gears is required, the teeth may be roughed out on another type of machine adapted for this work and the generator used only for finishing. The stroke of the tool is regulated by an adjustable crank, and the means for automatically lifting the tool during the return stroke is part of the shaper mechanism.

Operation of the Spacing and Generating Mechanism

The mechanism which serves to index the gear and impart a rolling motion to it is connected with the driving end of the machine by two shafts A and B, Fig. 4. The motion for indexing or spacing is derived from shaft A, which is splined and drives through spiral gears so arranged as to permit the generating head to move in any direction. The indexing mechanism has an intermittent or Geneva wheel motion and change-gears which are in action during the return stroke of the tool. When the tool is cutting, a pawl engages a spacing wheel which is so located as to insure accurate indexing, irrespective of lost motion in the change-gears.

The rolling motion is derived from shaft B, which is revolved at whatever speed is required to obtain a suitable rate of feed, depending upon the pitch, number of teeth, and material to be cut. A circular design of geared feed-box is located at the left-hand end of shaft B, beyond the range

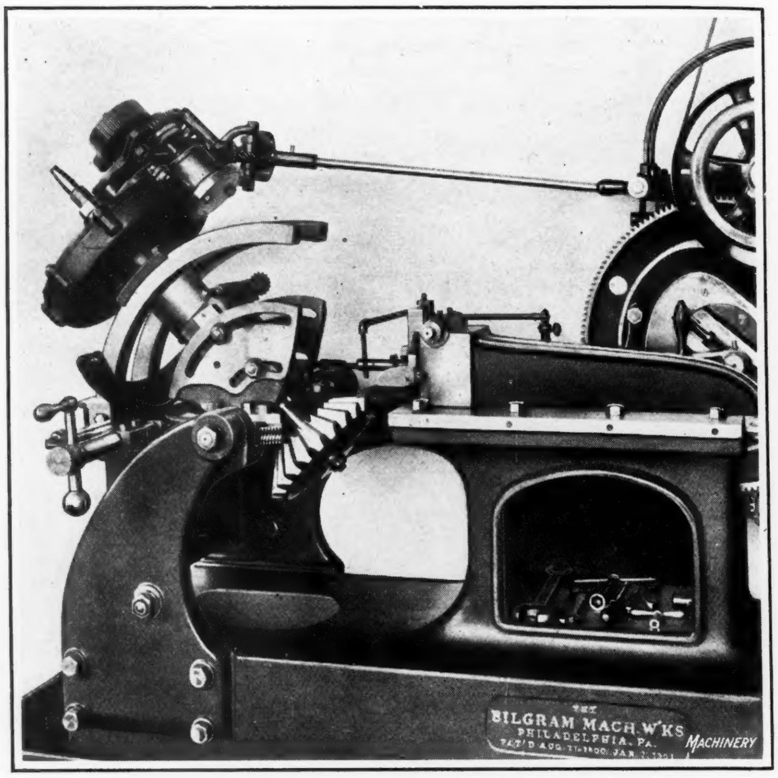


Fig. 3. Bilgram Bevel Gear Generator

of this particular illustration. The cross-shaft *C*, driven by *B*, carries a worm which meshes with a worm-wheel segment attached to the base connecting with the main work-spindle. The vertical axis of this worm-wheel segment coincides with the axis of the imaginary crown gear previously referred to and represented by axis x in Fig. 1. The cone segment *D* corresponds, at least approximately, to the pitch cone angle of the gear to be cut, and rolls on a horizontal surface as the worm-wheel segment turns slowly about its vertical axis. This cone segment is attached to segment-shaped bars *E* by clamps at *F*, the latter providing means of adjustment according to the angle at which the work-spindle is set. (The arrangement of the cone segment and supporting bars is shown more clearly in Fig. 3, as the machine happens to be equipped with a cone segment of larger radius.)

The rolling motion is controlled by two steel bands *G*, Fig. 4, which are attached at one end to the cone segment and at the other end to the horizontal bar. With this arrangement, when the worm on shaft *C* revolves the worm-wheel segment, the cone segment *D* rolls along on its horizontal surface, representing the pitch surface of the crown gear; consequently, the work-spindle has a rotary motion about its axis, and at the same time swings bodily about the axis of the imaginary crown gear. The result is that the gear being cut is given a correct generating motion relative to the planing tool. The machine is equipped with a series of cone segments of different angles which are selected in accordance with the pitch cone angle of the gear that is to be cut.

General Method of Adjusting the Machine

When setting up a machine, the work-spindle is first adjusted according to the pitch cone angle of the gear to be cut. The segment and worm for making this adjustment are shown at *H*, Fig. 4. A pitch cone segment is selected which is nearest to the pitch cone angle of the gear. If the latter angle is about midway between two segment angles, preference is given to the smaller angle. The pitch cone segment is attached to bars *E*, as mentioned previously, and steel bands leading from each end of the segment to opposite ends of the horizontal "cone bar" are attached and stretched moderately tight. The change-gears and anchor wheel of the indexing mechanism are selected according to the number of teeth in the gear. These change-gears are located at *N* on the outside of the spacer housing.

As the planing tool must travel parallel with the bottom of the tooth space, it is necessary to make an adjustment equal to the dedendum angle. This is done by adjusting the entire generating mechanism, which is supported on each side by trunnions *J*. A screw connected with handwheel *K* is used, and the angle of adjustment is determined by graduations on scale *L* in conjunction with graduations on a bevel surface of the handwheel.

When the blank is properly set, the apex of its pitch cone coincides with the axis of trunnions *J* of the generating mechanism, which axis also intersects the vertical axis of the imaginary crown gear. The gear to be cut is adjusted axially, or in the direction of the work spindle, in order to locate the apex of the pitch cone in the right position. Small gears may be clamped to a mandrel which is adjusted longitudinally, but larger gears should be clamped against the lower end of the spindle with bushings between to get the proper adjustment. While adjustable collars may be used, solid collars faced to the required thickness are preferred. After the gear blank is clamped, its location is checked by a height gage set to the height of the tooth. Thus the gear blank is raised or lowered until this gage, when turned down into contact with the edge of the blank, gives a reading equal to the required tooth height. The accuracy of the blank is then checked by allowing the blank to make about one-quarter turn and repeating the height gage test three times.

As a final check, a distance piece, in conjunction with a gage bar of the machine, is used to determine the apex distance of the gear. While this measurement is being made, the generator should be in its central or zero position as r gards the feeding motion. While the apex distance, to be strictly correct, should be measured when the generator is set horizontally or with the addendum

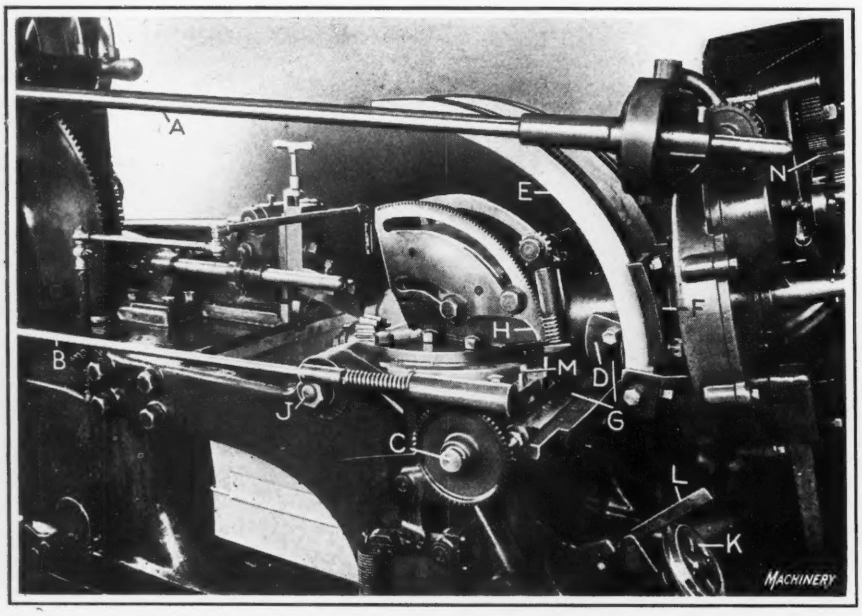


Fig. 4. Detail View of Another Bilgram Generator

angle at zero, this discrepancy can do no harm if the apex distance actually measured is noted and the mating gear is afterward set to the same distance.

Tools Used on the Bilgram Machine

There are three tools in a set. One is for stocking out, and there are right- and left-hand side-cutting tools for finishing opposite sides of the teeth. These tools may be ground on a surface grinder by using a holder supplied for this purpose. When a gear is to be roughed out on a machine, the stocking tool is set in a central position. A mark on the tool-slide shows when the tool is in the center. Thin packing strips are used with the smaller 6-inch machine. When using the side-finishing tools, the tool is set so that

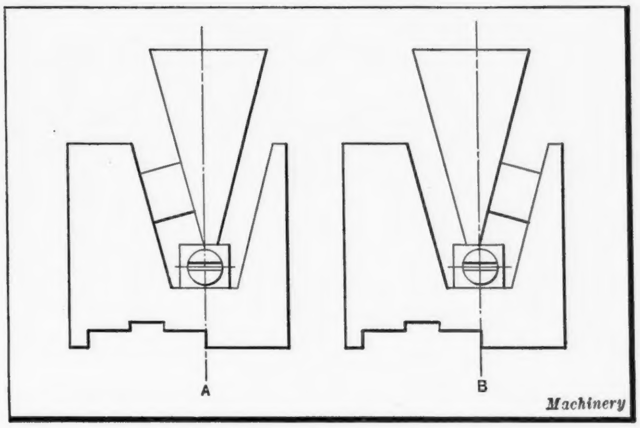


Fig. 5. Diagram showing Method of setting Tools on Bilgram Generator

the point or corner of the cutting edge is in the central position, as illustrated in Fig. 5, which shows the right- and left-hand tools.

Only one side of the teeth can be generated at a time, because of the forging form of the tooth spaces. The finishing tool must be set so that the lowest point of the cutting edge moves in a direct line toward the apex of the pitch cone or the center of the generator. The proper adjustments are obtained by a tool gage and gage-block illustrated in Fig. 5. The side-cutting tools have side slope or rake to give a better cutting action, whereas the stocking out tool is ground square across the end. When cutting some gears, such as soft bronze, for example, the tools with side rake may tend to gouge into the teeth and then the stocking out tool may be used for the side finishing cuts. When taking these finishing cuts, the lower edge of the tool should clear the bottom of the tooth space, as such contact sometimes causes chattering.

Angular Adjustment of Blank to Obtain Convergent Form of Tooth Space

The opposite sides of tooth spaces must be cut at slightly different angles, because both sides converge toward a common apex. For this reason, after the teeth are finished on one side, the gear is given an angular adjustment called the "shift." The master pinion engaging the master indexing or spacing gear, is so held that its position can be changed independently of the anchor wheel and change-gears. This movement is measured by a vernier scale. It is advisable to set the scale at zero when stocking out gears, and when finishing the sides of the teeth one-half of the amount of shift prescribed on the blueprint or shop order should be allowed on each side of the zero position. It is not necessary that the total shift be divided into equal parts, so long as this total amount is obtained when shifting from one side of the teeth to the other.

The feeding mechanism through which shaft *B* Fig. 4 is rotated, is set, not only with reference to the pitch of the teeth and the material, but also for roughing and finishing cuts. Thus, for finishing, a considerably higher rate is usually permissible than for roughing cuts. The feed may also be increased when stocking out, during the time the tool is approaching and after it has passed the middle position where the cutting is heaviest. Provision is made for reversing the direction of this feeding motion. The stop-pin *M* is placed on one side or the other according to the direction of feed, and fixed stops are also provided to insure stopping the machine if the operator should neglect to insert the adjustable stop-pin.

General Method of Operating Machine

After all adjustments have been made, the generating head is moved by hand for locating the blank in the proper position preparatory to starting the cut. The handle used for this adjustment is on the opposite end of feed-screw *C* (see Figs. 3 and 4). The feed mechanism is disengaged for this hand adjustment by loosening a knob in the front of the handle. The blank is first rolled away from the operator far enough for the tool to clear it; then, after starting the machine, the blank is brought back to a point where the tool begins to cut. Then the automatic feed is engaged. The direction of the feeding movement is controlled by a reversing knob on the feed-box. The shift vernier should be set at zero for the stocking out cut, assuming that the gear is roughed out on the same machine used for finishing.

The first finishing cut is taken with that tool which cuts on the side farthest from the operator. This is the right-hand tool, and it is set so that the lower corner is in the central position as shown at *A*, Fig. 5. The shift vernier which has plus and minus graduations, is set on the plus side an amount equal to one-half of the shift required. After the blank has again been rolled away from the operator by the hand adjustment, and the geared feed-box is set for a coarser feeding movement, the finishing cut on one side of the teeth is taken. This cut is sometimes repeated to eliminate any inaccuracies due to springing action. Before taking the finishing cut with a left-hand tool, the shift vernier is set by the minus scale to one-half the shift required, and the feeding motion is reversed.

* * *

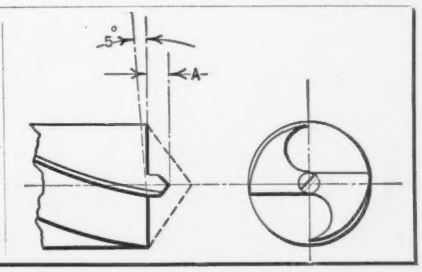
DRILL DIMENSIONS FOR TIN-PLATE DRILLING

By A. A. MARGIN

Holes larger than 5/16 inch in diameter cannot be drilled satisfactorily in tin plate with drills ground in the usual way. Even when a small lead-drill is used first and then followed up with a larger drill, the hole produced is likely to be over size, out of round, off center, and in some instances badly shattered. These defects may also result from the use of a combination centering drill.

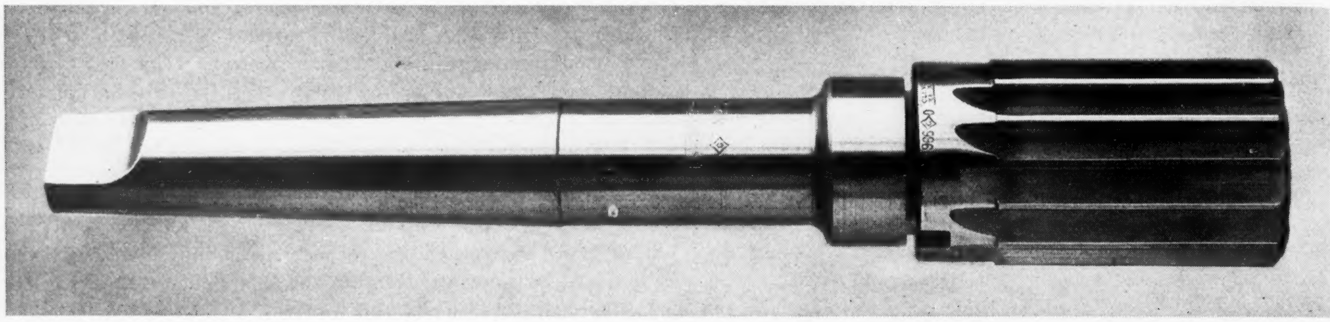
The writer has found that such difficulties may be avoided by grinding the drills in accordance with the data given in

Size of Drill, Inches	Dimension A, Inch
5/16 to 5/8	1/8
5/8 to 1 1/8	3/16
Over 1 1/8	1/4



the accompanying table. This table has been used to advantage in the tool-room when drilling tin-plate templets for laying out purposes. This work frequently requires the drilling of a large number of holes of different sizes, each of which must be round and accurately positioned.

A good example of the kind of work for which these specially ground drills proved satisfactory was a 12- by 12-inch plate, 1/16 inch thick, requiring ten accurately spaced holes ranging in size from 5/16 to 1½ inches in diameter.



Standardizing Shell Reamers and Arbors

Standard Dimensions Governing the Fits, and Gages Used for Inspection

By H. S. KARTSHER, Mechanical Engineer, The Cleveland Twist Drill Co., Cleveland, Ohio

CONSIDERABLE trouble has been experienced in the past with shell reamers and shell drills not fitting properly on the arbors used for driving them. This was due to the fact that different manufacturers had their own standards, and not more than two or three of the dozens were alike. Consequently, the reamers bought from one manufacturer would not fit the arbors of another. To eliminate this difficulty, the Drill and Reamer Association has specified that the reamer holes be made to a taper of 1/8 inch per foot on the diameter, that the arbors be tapered to correspond, and that the driving slots in the end of reamers and the lugs on arbors be made in accordance with the dimensions given in Table 1.

The various letters in this table refer to the dimensions indicated by the same reference letters in Fig. 1, where the taper of the arbor and reamer hole is shown considerably exaggerated for the sake of clearness. All tools made to these dimensions are to be stamped with a block letter S to distinguish them from tools made to old standards. The Cleveland Twist Drill Co. has set certain allowances and tolerances on these dimensions, and in the following a resumé of these fits will be given, together with a description of the gages used for inspecting the tools to see that they are machined to the correct size. It is only by adhering to a uniform system of tolerances in gaging of this kind that true interchangeability and satisfactory service to customers can be obtained.

Allowances and Tolerances for Fits on Taper Surfaces

In order to insure a good fit on the taper surfaces, an allowance E, Fig. 1, is made between the face of the reamer, when seated on the arbor, and the face of the arbor collar. Tolerances are placed on the large diameter of the hole in the reamer and on the diameter of the arbor (disregarding the recess near the collar) at a point located a distance E from the collar face, the basic diameter given for H being the minimum diameter in the case of the reamer, and the maximum in the case of the arbor. These tolerances are expressed in terms of length with respect to the taper surface, and permit each member to absorb 25 per cent of the basic allowance between the reamer face and the face of the arbor collar, so that should the reamer hole be made to the maximum diameter and the arbor surface to the minimum, there would still be left 50 per cent of the allowance to provide for wear. The limits on the diameter of the hole in the reamer at the large end and the diameter of the arbor at the gaging point, and the tolerance on these diameters, are given in Table 2.

On account of the fact that it is impossible to machine the driving lugs of the arbor in absolute alignment with the center of the reamer hole, a tolerance X is established to meet this condition. The formula for this tolerance is:

$$X = \frac{0.40\ (C - A)}{2}$$

in which

X = amount each member may be off center in either direction;

C = minimum (basic) width of slots in reamer; and

A = maximum (basic) width of lugs on arbor.

The difference between a minimum width slot and a maximum width lug is 1/64 inch in all cases, and so the solution resolves itself into

$$X = \frac{0.40 \times 0.015625}{2} = 0.003125 \text{ or } 0.003 \text{ inch}$$

for every size of reamer.

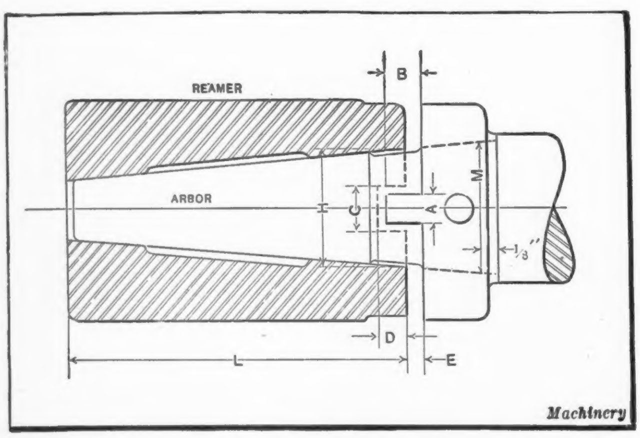


Fig. 1. Illustration showing on an Exaggerated Scale the Fit of a Shell Reamer on its Arbor

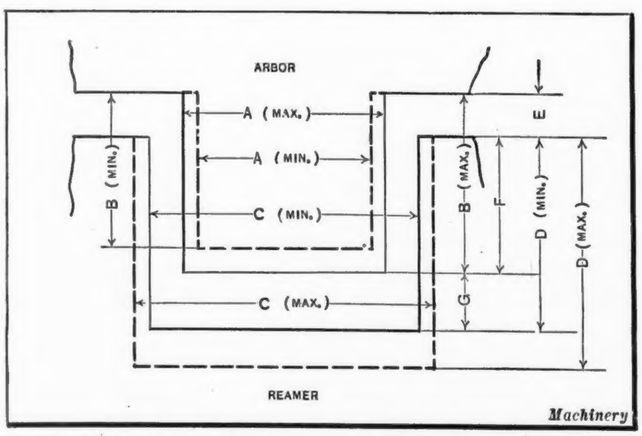


Fig. 2. Diagram showing Limits on Driving Lugs and Slots of Reamers and Arbors

It will be seen that in allowing the slots in the reamer and the lugs on the arbor to be off center an amount equal to 40 per cent of the smallest clearance, there still remains 20 per cent of that clearance even though both members should be out of true the maximum amount in opposite directions. Table 3 gives the maximum and minimum limits both for arbor lugs and reamer slots, as well as the driving length *F*, Fig. 2, and the clearances *E* and *G*.

The Master Gages

Before starting the manufacture of reamers and arbors, it was necessary to establish a sequence of operations and a system of gaging, the first gages required being three master gages. That known as the "master reamer" is shown in Fig. 3. The hole and the slots are made to very small tolerances, and correspond as nearly as possible to the dimensions of a reamer having a minimum diameter hole and size of slots, and any arbor which fits this gage will fit any reamer passing the inspection gages. The driving lugs and the taper surface of the master arbor illustrated at *V*, Fig. 7, are made to very small tolerances, and correspond to the dimensions of a maximum size arbor. Consequently a reamer which fits this gage will also fit any arbor passing the inspection gages.

Testing the Taper of Master Taper Plug Gages

The master taper plug gage shown at *W* is used in the manufacture of the other gages, the correct taper being determined within very close limits by setting up a pair of parallels with two different sizes of B. & S. ground disks spaced the proper distance apart by means of standard gage-blocks, as shown in Fig. 4. The middle line *H*, Fig. 7, of the three etched lines on the gage is located at a point where the tapered part is equal in diameter to the basic gage dimension *H* in Table 1, and the other two lines are located at points where the tapered part is equal in diameter to certain of the inspection gages ground to this master. All the gages considered in this article have a flat surface to provide a space for identification marks, such as the tool number, basic diameter, number of hole, trademark, and the block letter S previously mentioned. Master gages are also stamped with a letter M to distinguish them from inspection gages, which are stamped with the letter I.

TABLE 1. REAMER AND ARBOR DIMENSIONS ADOPTED BY THE DRILL AND REAMER ASSOCIATION*

Arbor No.	Diam. of Reamer Hole, Large End, Inches	Arbor Lugs		Driving Slots		Reamer Length, Inches
		Width, Inches	Depth, Inches	Width, Inches	Depth, Inches	
	H	A	B	C	D	L
3	0.250	7/64	1/8	1/8	5/32	2
4	0.375	9/64	5/32	5/32	3/16	2 1/4
5	0.500	11/64	7/32	3/16	1/4	2 1/2
6	0.625	11/64	7/32	3/16	1/4	2 3/4
7	0.750	15/64	9/32	1/4	5/16	3
8	1.000	15/64	9/32	1/4	5/16	3 1/2
9	1.250	19/64	11/32	5/16	3/8	3 3/4
10	1.500	19/64	11/32	5/16	3/8	4
11	1.750	23/64	13/32	3/8	7/16	4 1/2
12	2.000	31/64	15/32	1/2	1/2	5
13	2.250	31/64	15/32	1/2	1/2	5 1/2
14	2.500	39/64	9/16	5/8	5/8	6
15	2.750	39/64	9/16	5/8	5/8	6 1/2

Machinery

*See Fig. 1 for the notation in this table.

Manufacturing the Reamers and Arbors

As this article deals with the fit of shell reamers and their arbors, only such points in their manufacture as affect the fit will be considered here. The first operation on a reamer consists of reaming the hole to fit the plug gage shown at *X* in Fig. 7. Line *H* of this gage should be about 1/2 inch from the large end of the reamer to allow about 0.005 inch of stock in the hole for grinding after hardening. After that operation the gage must go into the reamer hole to line *H* at which point the diameter is the basic dimension given in Table 1. An axial tolerance *K*, equal to that specified in Table 2 for the proper size of arbor, is permitted.

Previous to hardening the reamer, the driving slots are milled to the limit plug gage shown at *X* in Fig. 5. On this, the "Go" and "Not Go" gaging surfaces are made to the minimum and maximum dimension *C* given in Table 3. As the depth of the slots has a tolerance of 1/64 inch, a scale measurement is considered sufficient in determining this dimension. After milling the slots, their alignment with the center of the hole is tested by means of the gage shown at *Z*, Fig. 7. A sliding sleeve on this gage carries a lug of a width *R* which is equal to the width of the minimum slot on a mating reamer, as given in Table 3, minus 0.006 inch to allow the slots to be off center 0.003 inch in either direction. After hardening the reamer and grinding the hole, this gage is again used to ascertain whether the slot width has changed in hardening; if this is the case, the interference must be ground away.

By again referring to Fig. 1, it will be seen that an arbor consists of two parts, a collar being driven on the arbor proper and pinned to it. The arbor proper is first turned to suit the gage shown at *X* in Fig. 6, on which diameter *M* corresponds to diameter *M* in Fig. 1; this dimension is 0.010 inch larger than the finished diameter of the tapered part carried to a point 1/8 inch from the shoulder provided on the arbor for seating the collar. The short pin projecting from the face of this gage is intended to come flush with the shoulder on the arbor or not reach it, while the large plug must reach the shoulder. The long pin is 0.400 inch longer than the short one and allows from 0.010 to 0.014 inch of stock on the diameter for subsequent grinding. The arbor

TABLE 2. LIMITS AND TOLERANCES FOR THE FITS OF SHELL REAMERS ON THEIR ARBORS*

Arbor No.	Arbor			Reamer			Allowance E	
	H (Min.) Inches	H (Max.) Inches	Tolerance K, Inches	H (Min.) Inches	H (Max.) Inches	Tolerance K, Inches	Min. Reamer and Max. Arbor, Inches	Max. Reamer and Min. Arbor, Inches
3	0.2498	0.250	0.0156	0.250	0.2502	0.0156	0.0625	0.0312
4	0.3748	0.375	0.0156	0.375	0.3752	0.0156	0.0625	0.0312
5	0.4997	0.500	0.0234	0.500	0.5003	0.0234	0.0937	0.0469
6	0.6247	0.625	0.0234	0.625	0.6253	0.0234	0.0937	0.0469
7	0.7497	0.750	0.0234	0.750	0.7503	0.0234	0.0937	0.0469
8	0.9997	1.000	0.0312	1.000	1.0003	0.0312	0.1250	0.0625
9	1.2497	1.250	0.0312	1.250	1.2503	0.0312	0.1250	0.0625
10	1.4997	1.500	0.0312	1.500	1.5003	0.0312	0.1250	0.0625
11	1.7495	1.750	0.0469	1.750	1.7505	0.0469	0.1875	0.0937
12	1.9995	2.000	0.0469	2.000	2.0005	0.0469	0.1875	0.0937
13	2.2495	2.250	0.0469	2.250	2.2505	0.0469	0.1875	0.0937
14	2.4993	2.500	0.0625	2.500	2.5007	0.0625	0.2500	0.1250
15	2.7493	2.750	0.0625	2.750	2.7507	0.0625	0.2500	0.1250

Machinery

*See Figs. 1, 6, and 7 for the notations in this table.

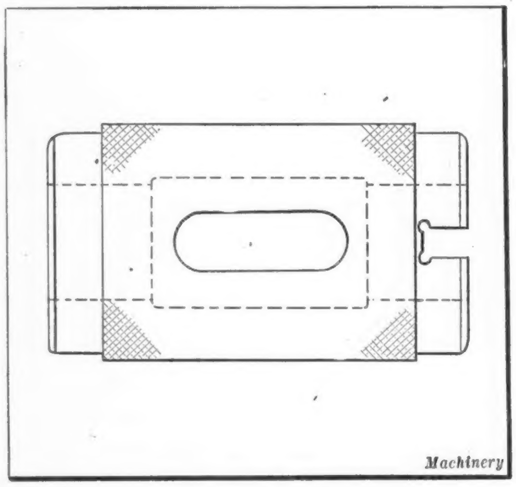


Fig. 3. Master Reamer made to Minimum Reamer Dimensions

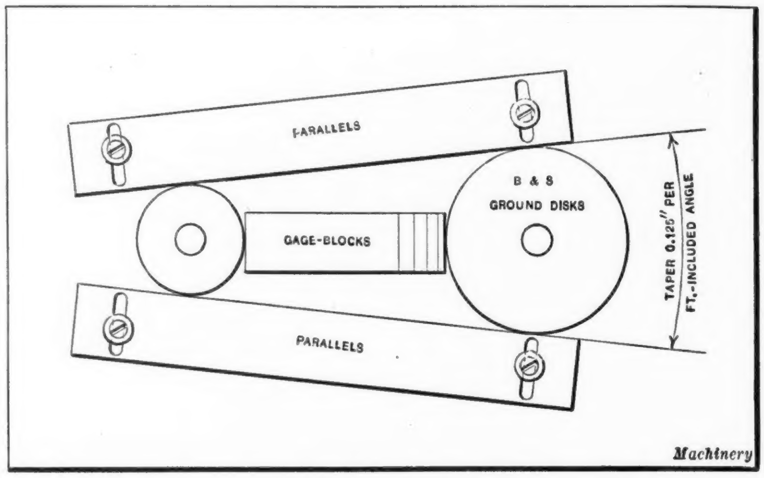


Fig. 4. Set-up of Parallels, Disks, and Gage-blocks to test the Taper of the Gage shown at W, Fig. 7

is finally recessed, as illustrated in Fig. 1, in order to facilitate the grinding of the taper surfaces after the collar is pressed on.

The arbor collar is first reamed to suit the requirements of the plug gage shown at *Y*, Fig. 7, on which the larger

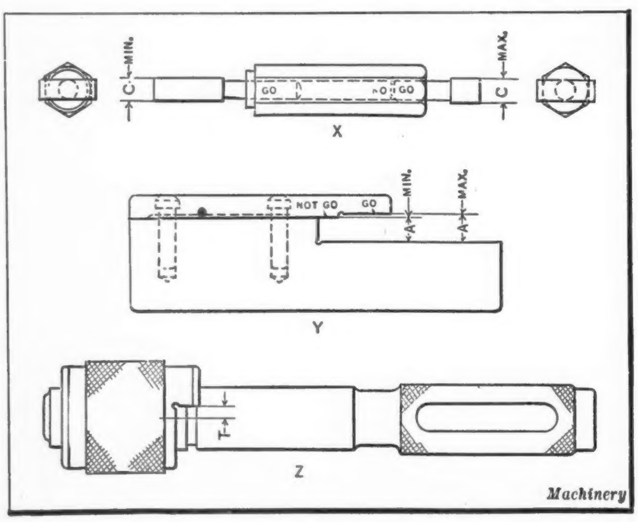


Fig. 5. (X) Gage for inspecting Width of Reamer Slots; (Y) Gage for determining Width of Arbor Lugs; (Z) Gage for testing Alignment of Lugs on Collar

diameter of the etched band is the same as diameter *M* on the gage at *X* in Fig. 6. Thus should a maximum size collar and a minimum size arbor be assembled, there would be an axial allowance of 1/8 inch for a driving fit. If this allowance is exceeded, the collar must be reamed again until it rests 1/8 inch from the shoulder of the arbor. By this method there is always sure to be sufficient stock for a driving fit.

The lugs on the collar are next milled to the correct widths, as determined by the gage shown at *Y* in Fig. 5, the

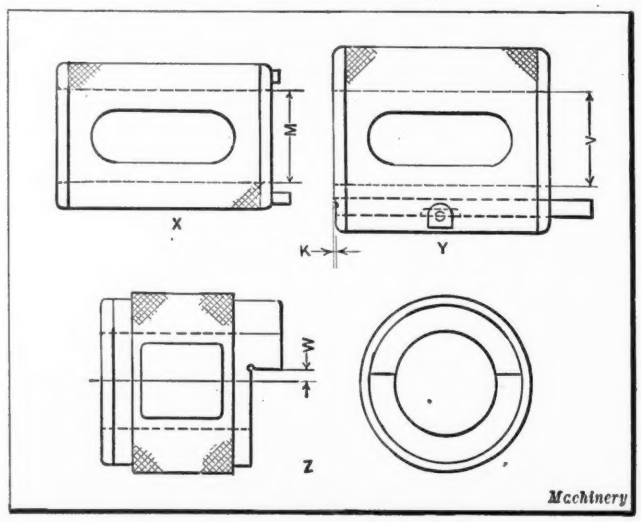


Fig. 6. (X) Gage to which Taper of Arbor is turned; (Y) Flush-pin Gage for Final Inspection of Taper of Arbor; (Z) Gage for testing Alignment of Lugs after Assembly

gaging surfaces of which are made to the maximum and minimum dimensions *A* in Table 3. As a tolerance of 1/64 inch is allowed on the length of the lugs, scale measurement is considered sufficient for determining this dimension. The

TABLE 3. LIMITS OF REAMER SLOTS AND ARBOR LUGS*

Arbor No.	Lug Limits, Inches				Slot Limits, Inches				Clearance and Driving Contact (Basic), Inches		
	Width A		Depth B		Width C		Depth D				
	Max. (Basic)	Min.	Max. (Basic)	Min.	Max.	Min. (Basic)	Max.	Min. (Basic)	E	F	G
3	0.1094	0.1044	0.1250	0.1094	0.1300	0.1250	0.1719	0.1563	1/16	1/16	3/32
4	0.1406	0.1356	0.1563	0.1407	0.1613	0.1563	0.2031	0.1875	1/16	3/32	3/32
5	0.1719	0.1669	0.2188	0.2032	0.1925	0.1875	0.2656	0.2500	3/32	1/8	1/8
6	0.1719	0.1669	0.2188	0.2032	0.1925	0.1875	0.2656	0.2500	3/32	1/8	1/8
7	0.2344	0.2284	0.2813	0.2657	0.2560	0.2500	0.3281	0.3125	3/32	3/16	1/8
8	0.2344	0.2284	0.2813	0.2657	0.2560	0.2500	0.3281	0.3125	1/8	5/32	5/32
9	0.2969	0.2909	0.3438	0.3282	0.3185	0.3125	0.3906	0.3750	1/8	7/32	5/32
10	0.2969	0.2909	0.3438	0.3282	0.3185	0.3125	0.3906	0.3750	1/8	7/32	5/32
11	0.3594	0.3534	0.4063	0.3907	0.3810	0.3750	0.4531	0.4375	3/16	7/32	7/32
12	0.4844	0.4784	0.4688	0.4532	0.5060	0.5000	0.5156	0.5000	3/16	9/32	7/32
13	0.4844	0.4784	0.4688	0.4532	0.5060	0.5000	0.5156	0.5000	3/16	9/32	7/32
14	0.6094	0.6034	0.5625	0.5469	0.6310	0.6250	0.6406	0.6250	1/4	5/16	1/4
15	0.6094	0.6034	0.5625	0.5469	0.6310	0.6250	0.6406	0.6250	1/4	5/16	5/16

Machinery

*See Fig. 2 for the notation in this table.

alignment of the lugs with the center of the hole is tested by means of the gage *Z*, Fig. 5, on which dimension *T* equals one-half the maximum dimension *A*, Table 3, plus 0.003 inch to allow a maximum lug to be off center 0.003 inch. It will be obvious that a minimum width lug can be off center more than a maximum width lug.

After milling these driving lugs, the collar is fitted, pressed on the arbor and pinned in place. It is then turned down flush with the arbor shank, and the taper surface of the arbor ground to the flush-pin gage shown at *Y* in Fig. 6. The large end *V* of the hole in this gage is ground to a diameter which, on a finish-ground maximum size arbor, causes the face of the gage to rest 1/8 inch from the lugs on the arbor collar. In this position if one end of the sliding pin is placed against the face of the collar, the other end will be flush with the lower step on the rear end of the gage. On a minimum size arbor, the gage will rest closer to the lug and the rear end of the sliding pin will be flush with the high step.

The last gage used in the inspection of an assembled arbor and collar is that shown at *Z*, Fig. 6. This is used to make a final test of the alignment of the driving lugs with the center of the arbor. Dimension *W* is equal to one-half of the maximum dimension *A* as given in Table 3, plus 0.003 inch, and if an arbor passes this gage, it is pronounced satisfactory. It will be apparent that this gage is used for testing both sides of the lugs. In the tables arbors Nos. 1 and 2 are not considered, as they are special sizes and seldom used.

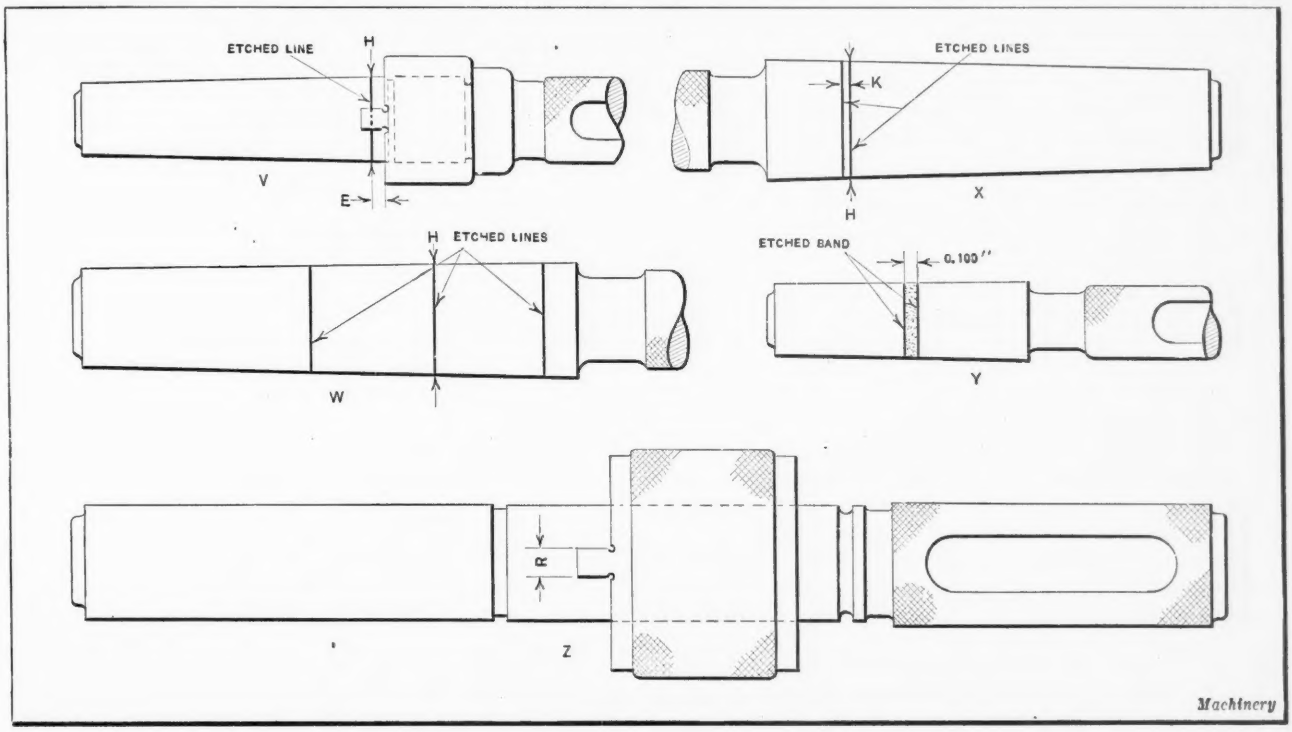


Fig. 7. Plug Gages used in manufacturing Standard Reamers and Arbor Collars

* * *

ACTIVITY IN THE RAILWAY FIELD

While the railroads have not as yet placed large orders for machine tools, they have started a buying campaign which doubtless will be extended to the tool equipment field. The net operating income of the railroads has steadily increased, and their financial position today is better than it has been for many years past. Up to May first 52,000 freight cars had been ordered—a larger number than has been ordered in any year since 1918. It is evident that the railroad managers are looking forward to heavy freight traffic. The increased activity in railroad buying has favorably affected the sales of electric furnace equipment as reported by one of the electric furnace companies. These furnaces are used for manganese steel castings for railroad purposes.

DULLNESS IN FRENCH MACHINE TOOL MARKET DUE TO UNCERTAINTY

A well-known representative in France of an American manufacturer of metal-working machinery states that the stagnation of the French market in machinery of this type is due to the inability of the consumer to foretell the financial situation with any certainty, and the manufacturer who would bring his plant up-to-date with modern equipment is unable to do so, because he cannot determine whether or not there will be any returns on the investment. The manufacturer who finds that he can buy a machine tool of either French or German make very much cheaper than an American machine, naturally will turn either to the home industry or to the German market—sometimes without a thought as to whether the machine that he buys will actually serve his purpose as well as the more expensive American product.

As a matter of fact, he does not know definitely what the relative values of the machines are, because he has nothing upon which to base his judgment but the enthusiasm of the parties most interested—the French distributor of the American machine on the one hand, and the French or German manufacturer on the other. Furthermore, he often fears that it would be difficult to obtain repair parts in case the American machine is not one that is well known and generally used in France. He had the same idea about Ford cars and Kodak cameras, but he has changed his mind because these big-scale American producers have realized that they had a big market, and they were able to cultivate it until they ultimately found that they had a better field to till than they had expected.

Is there any way out for the American machine tool manufacturer? The larger ones possibly could manufacture, or at least assemble, in France. This would be one way, and perhaps the only way, in which to overcome present difficulties. In that case association with the right kind of French industrial enterprises might be desirable. The idea may be impracticable, but it would be worth while investigating.

* * *

The improvement in the iron and steel field is encouraging. Structural steel particularly is in great demand. Orders for fabricated structural steel placed during April were almost equal to the capacity of the fabricating firms.

Tool Supply and Stock-carrying Methods

A Description of a Tool Supply System in a Contract Plant and a Discussion of the Inspection and Repair of Equipment and the Carrying of Adequate Stock

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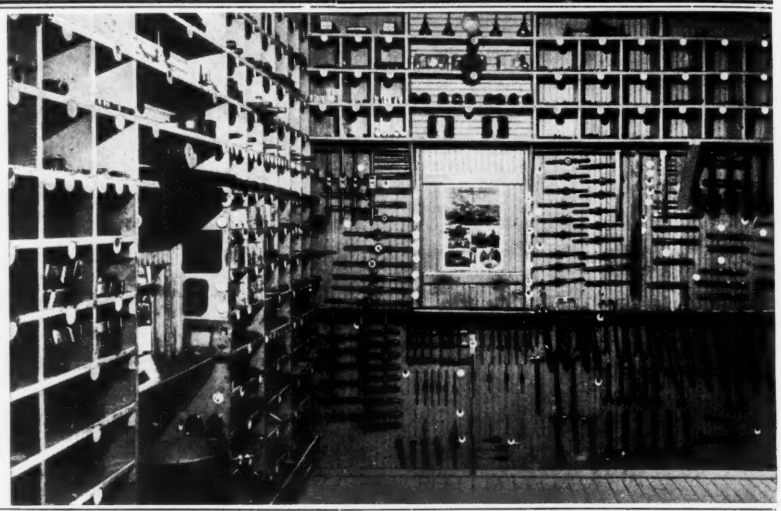


TOOL issue rooms or tool cribs, as they are commonly called, are found in almost every machine shop. Here tools are taken care of and issued to the workmen without delay, and records are kept of the men to whom the tools are lent. In large shops, it is usual for each department to have a tool issue room, and in such cases it is a good plan to have a central tool store-room in which reserve stocks of standard tools are kept and supplied to the issue rooms as required. The tool supply system should be so organized as to render the best possible service to the shop, and in order to attain this end, the tool store-room and all issue rooms should be under the authority of one foreman responsible to the general foreman. The tool foreman should turn over all routine work to subordinates so that his time may be devoted to supervising the force and attending to the more important matters that arise. Every other man in charge of a section of the tool supply system should be held strictly accountable for the condition of tools or records under his care and for the quality of service rendered by his section.

The equipment of the tool store and issue rooms consists primarily of facilities for stowing tools in the most accessible manner. Open shelves should be used whenever possible, and bins or pockets may be employed when it is necessary to prevent the stock from rolling on the floor. Drawers should be used only as a last resort, because they hamper inspection and encourage careless stowing. Revolving racks and other special equipment are sometimes necessary to facilitate stowing or handling. The heading illustration shows a tool issue room in which the tools are stored in an ideal manner. The stock that is on hand of each particular tool should be large enough to meet all reasonable demands of the shop, but care should be taken not to overstock.

DEPT. ______ ITEM ______
SECTION ______ SYMBOL ______ SIZE ______
COST ______ PER ______ MAX. STOCK ______ MIN. STOCK ______

ORDERED			DATE	RECEIVED		ISSUED		BAL.	DATE	RECEIVED		ISSUED		BAL.
DATE	REQUEST	PCS.		STUB	PCS.	STUB	PCS.			STUB	PCS.	STUB	PCS.	

AF—TOOL INVENTORY CARD CARD NO. ______

Fig. 1. Inventory Form for keeping Record of Stock on Hand of Standard Tools in General Use in the Shop

In the following some of the duties of the members of a tool supply system are outlined.

Duties of the Tool Store and Issue Room Forces

Tool Foreman—The tool foreman is in complete charge of the tool store-room and the tool issue rooms, and is directly responsible to the general foreman. He should personally attend to the following duties, or see that they are definitely assigned to competent assistants: Assigning all new tools to the proper inventory class, depending upon whether they are standard, odd sizes, or special; examining all damaged tools and arranging for their prompt disposal; rendering a decision on any question as to the serviceability of such tools as short taps and badly worn dies; conferring with the technical advisor concerning special tools for new machines and procuring those necessary; issuing requests for new tools after reviewing the reports of the tool store-keeper and making a careful study of the tool inventory; and arranging for a periodic checking of the tool inventory, so the total inventory will be checked at least once a year.

Tool Store-keeper—The tool store-keeper should be next to the tool foreman in charge of the tool store-room, and should be responsible for keeping the records, including cards and damage reports. Three special inventories should be kept, one each for standard, odd-sized, and special tools. The inventory of all standard tools in the tool store-room, the tool issue rooms, and the forging shop for redressing, may be kept on a form such as illustrated in Fig. 1. The back of this card is identical with the front so as to permit the use of both sides. The balances on these cards should control the ordering of new tools. All cases of shortage and demands for new tools should be reported to the tool foreman. Whenever tools are requested, the date, requisition

ITEM

FOR

LOCATION ______ SYMBOL ______ DATE ______

DAMAGED		REPAIRS OR ALTERATIONS	DATE REPLACED
DATE	BY		
432--RECORD FOR SPECIAL TOOLS AND JIGS			

Fig. 2. Form used for keeping an Inventory of Odd-sized and Special Tools

number, and number of tools desired should be entered on the inventory cards under the heading "Ordered," and this entry should be checked off when the lot is received.

The inventory of odd-sized tools may be kept on the form shown in Fig. 2, the back of which is the same as the lower part of the front. Odd-sized tools should be handled in the same manner as standard tools, except that no reserve stock should be carried. They should be replaced or repaired as they become damaged, proper entries being made on the card. The inventory of special tools may also be kept on the form shown in Fig. 2. This class of tools should be handled in the same manner as standard tools, except that no reserve stock should be carried and they should not be replaced when damaged. When a special tool is discarded, the fact should be noted on the inventory card, and the latter removed from the file. The tool store-keeper should receive all new tools, and record them in the inventory file according to the classification assigned them by the tool foreman, and he should take care of reports and records of tools lost or damaged.

Supervisors of Issue Rooms—Each issue room or section of the tool store-room should be under the charge of a supervisor responsible to the tool foreman for the condition of tools under his care. The supervisor should frequently inspect all tools ready for immediate use and dispose at once of damaged or partly worn tools that may get into the racks. Doubtful questions as to serviceability should be referred to the tool foreman, as previously mentioned. He should also see that tools and receipt checks are in their proper places. As far as possible, tools should be stored according to their class; for example, lathe and planer tools should be placed in one section, taps and dies in another, and milling cutters and slitting saws in a third. Odd-sized tools should be kept with standard tools of the same kind, but special tools should be kept in an entirely different section. Standard tools of any one kind should be arranged according to their principal dimensions.

Caring for Precision Instruments

All precision instruments, such as micrometers, gages, straightedges, and vernier calipers should be returned to the tool issue rooms at the close of each working shift. These instruments should be kept separate from other tools, and before being placed in racks for re-issuing, they should be compared with working standards. The latter should never be issued or handled by anyone except the supervisor of the tool issue room. It is also well to remove any scratches or other blemishes from micrometers and gages before storing them for re-issue.

If the results are to be strictly reliable, there must be a routine system for adequate checking of the working standards. In a plant of considerable size there would probably be a precision laboratory, in which the working standards would be periodically checked against plant standards. At long intervals the plant standards themselves should be checked by the Bureau of Standards in Washington.

Inspection and Repair of Equipment

An anticipative inspection and preventive repair system is applicable to contract as well as manufacturing plants. Under this system, the equipment is listed and a definite interval is set for the inspection of each piece. At the appointed time, the equipment is examined by an inspector of the maintenance department, all work necessary to keep the equipment in working order is noted, and the work is done as soon as possible. The only peculiarity of this system as applied to the contract plant is that the inspection intervals are more difficult to set than when a plant is operated on a manufacturing basis, because of the irregular use of many of the machines. However, it has been found practicable to carry out this system so as to increase materially the reliability of the equipment and the chance of its being available when wanted. In a contract plant this factor is especially important, because there is often a sudden demand for the use of some equipment, and the need is likely to be an urgent one.

Before the installation of a system of this kind, supervisors generally are accustomed to calling for repairs to their equipment as they see necessary. They should continue to do this under the new system and should not place an overdependence on the system, or wait for the maintenance department to learn of the need of repairs in its routine inspection. The arrival of the time for this inspection does not justify the inoperation of equipment urgently needed; if necessary, the inspection should be delayed until a more convenient time. When an inspection of a piece of equipment is to be made, the inspector should interview the workmen and supervisors who operate the equipment and obtain a statement of their experience with it since the last inspection. By means of this information and such an examination of the equipment as may be possible during its regular operation, it may often be decided that a disassembly of the equipment is unnecessary.

Clamps, bolts, steadyrests, and other auxiliary equipment of machines should also be inspected regularly. It will often be found that the stock of such equipment is seriously depleted, in which case a replacement must be made. Such of this equipment as serves several machines is best kept in the tool-room when not in use, but articles that serve one machine only are often most conveniently located near that machine, provided arrangements are made to insure that the parts will not be carried away by unauthorized persons. In Fig. 3 is shown a method of locking wrenches to a machine to prevent losing them. Fig. 4 shows a lathe having a number of pieces of auxiliary equipment, including a tool box on the floor, a stand for collets and instruments, a portable light, and a crane for assisting in mounting or dismounting the chuck.

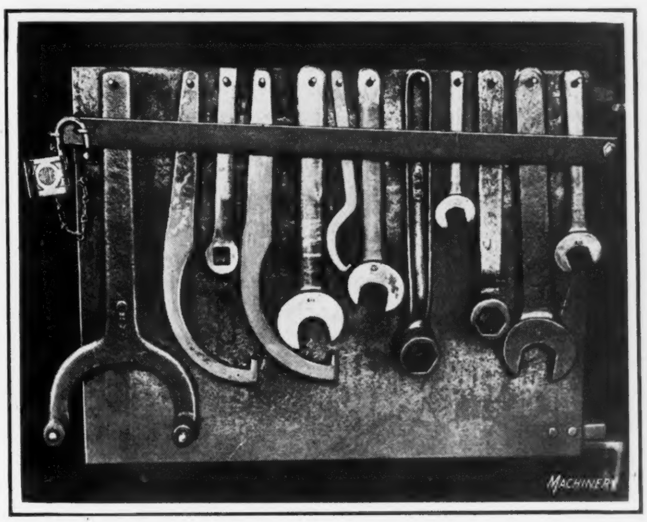


Fig. 3. Method of locking Wrenches to a Machine to prevent them from being lost or removed by Unauthorized Workmen

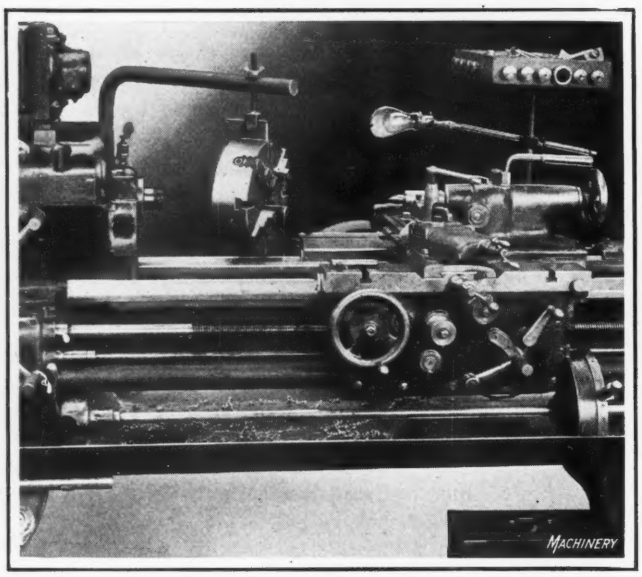


Fig. 4. Engine Lathe provided with such Auxiliary Equipment as a Chuck Crane, a Collet and Instrument Stand, and a Tool Box

Stock of Raw Materials and Completed Parts

The carrying of a reasonable stock of raw materials and completed parts is essential to the prompt filling of emergency and rush orders which are so common in contract or jobbing plants. Carrying a stock of completed parts also enables a plant to produce in quantities great enough for efficient operation, instead of wastefully making driblet orders of parts to customers' orders. However, with the continual change of work in these plants there is always a risk that any stock except that most essential will lie indefinitely in the store-room and perhaps never be used. The files of instruction cards of former work shown in the article "Planning in Large Contract Plants" in March MACHINERY, furnish the best data from which to decide what raw materials and completed parts should be carried in stock and between what limits. In the absence of such data, it is necessary to rely on the estimates of persons whose work brings them in touch with the subject. Experience has shown the great superiority of actual records. The estimates of such persons are of great value in correcting the figures of the past for the probable changes of the future, a matter which the jobbing plant least of all can afford to overlook.

In order to get the full benefit of the system of carrying stock, the planners must be kept fully informed of the stock on hand, as otherwise instead of drawing parts from stock, they will order them made in small quantities to suit a customer's order. To give planners adequate information along these lines, it is necessary to furnish them with an up-to-date stock catalogue. The difficulty of providing such data indicates that the decision as to drawing parts from stock or making them to order, should be made by the central planning office, because a small force of specially expert material men can be maintained there for this particular purpose.

One of the problems of keeping stores is to save materials left over. In a foundry having many emergency orders, where an excess allowance is molded and poured equal to a reasonable estimate of scrap loss, some castings are often left over. In a smith shop, also, ends of billets are left over, and in boiler shops, there is an excess of tube ends and plate clippings. Any shop will leave over broken packages of small articles usually bought outside. A convenient means of saving such materials is to establish a store-room in the shop, especially for left-over parts. Unless this is done, these parts are likely to lie about the shop indefinitely, contributing to the disorder of the shop and frequently resulting in a dead loss. The shops in a contract plant are often more or less inaccessible to the general store-room, and when much outside repair work is done it may be necessary to have small semi-detached shops on barges or railway cars. The degree of accessibility to the general store-room determines the amount of supplies which should be carried in their stores.

Salvaging Scrap and Discarded Parts

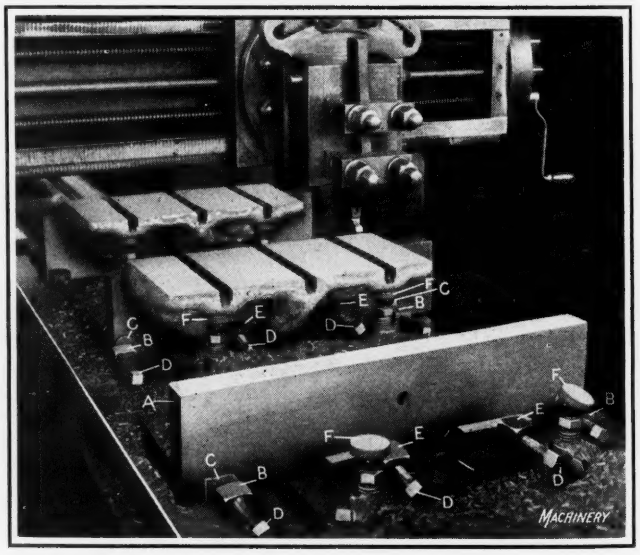
A repair shop, on account of the nature of its business, rapidly accumulates considerable scrap. The method of handling this material may make it a source either of expense or of considerable revenue. If the latter is to be the case, such materials must be handled by a competent salvage department. The first requisite for the efficient salvaging of this material is that it should be well sorted. This requires considerable room, but buildings of the cheapest construction, or even open bins, suffice. After it has been classified and sorted, the disposal of the material to the best advantage depends upon the skill of the salvage department, either in using it in the plant or selling it.

* * *

FIXTURE FOR PLANING ANGLE-PLATES

The accompanying illustration shows a Woodward & Powell planer set up for planing the top surface of an angle-plate for a Pratt & Whitney 6-inch vertical shaper. Before the operation is performed, the surface at the back of the work is finished, and this is used as a locating point for clamping the casting against an angle-plate fixture. A string of these castings is set up for planing. The arrangement of the clamping bolts, jacks, etc., may be clearly seen in the foreground, where one of the fixtures is shown with the casting removed. Provision must be made in this operation for supporting the end thrust of the tool, and this is accomplished by having stops *B* set in the table T-slots, which carry bolts engaging the front face of the fixture *A*.

In order to avoid damaging the finished surfaces of the fixtures, a sheet-metal shim *C* is placed between each clamping bolt and the fixture. It will be seen that there is a thin wall on each casting, the back face of which has already been planed, and this face is clamped against the fixture by two bolts *D* which are carried by stops *E*. The work is supported against the vertical pressure of the tool by means of two jacks *F*, the upper members of which are furnished with a ball and socket connection so that they will automatically adjust themselves for slight irregularities in the castings, and afford a uniform support. On this job the depth of cut is $\frac{1}{8}$ inch, with a feed of $\frac{1}{4}$ inch per table stroke and a cutting speed of 20 feet per minute, the material being cast-iron.



Planer equipped for planing the Tops of Angle-plates for Vertical Shaper

Building Special Machines for Can-Seaming

By ARTHUR MUMPER

MACHINE work of an interesting nature and calling for a high degree of accuracy is frequently met with in shops devoted to the construction of special machinery. The building of special machines, such as the can-seaming machine shown in Fig. 1, always has an interest for the machinist, and the shop doing this class of work usually experiences less difficulty from labor turnover than that engaged in general contract or repair work. In the plant of the Ackermann Mfg. Co., Wheeling, W. Va., where the Wheeling No. 100-A double-seamer shown in Fig. 1 is built, the work is done on a production basis, yet the management takes care not to advocate stereotyped high-production methods to the extent of lessening the men's interest in their work and killing any incentive for them to develop original methods of increasing production.

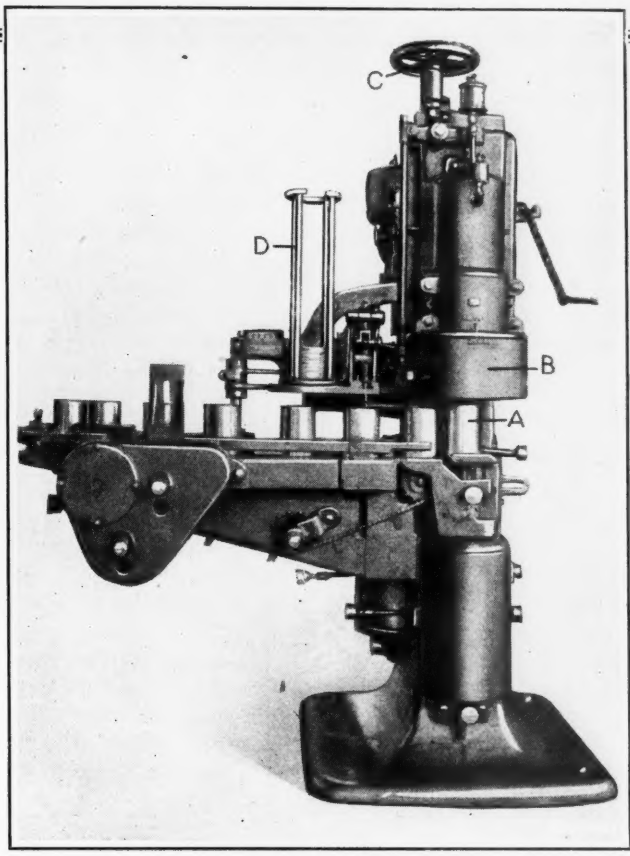


Fig. 1. Automatic Can-seaming Machine

A general line of machine tools is usually required in the manufacture of special machines like the double-seamer, or "can-closing machine," as it is also called. The machine work required in building the can-closing machine, like that required in building many other special automatic machines, includes gear-cutting and cam-cutting operations such as are seldom met with in repair shop work. The making of improvements on special machines taxes the ingenuity of the machinist in devising adequate means of machining new parts and thus increases interest in the work.

The can-closing machine represents a highly developed type of a strictly single-purpose machine. This machine is used to close the ends of cylindrical tin containers or cans after they have been filled at the packing plant. It is a patented machine, and it is claimed that it has a smaller number of working parts than any similar machine that is employed for the same purpose.

Operation of Can-closing Machine

The empty cans are placed in a trackway, and roll by gravity to an automatic filling machine. After being filled, they pass on to an endless belt which conveys them to the closing machine or double-seamer. The double-seamer handles the filled cans at the rate of sixty a minute without spilling the contents. It also straightens the cans, which are not perfectly round, before seaming the tops to the bottoms. The cans are not handled by the operator from the time they are first placed in the trackway until after they are packed and the ends seamed tight. After this seaming operation the cans will stand a pressure of from 40 to 45 pounds per square inch without leaking.

The curled edge of the can-end is rolled in under the flanged end of the can body which is thus made air-tight. This is done in two operations; the principle is practically the same as that involved in the construction of other can-closing machines, the can body being carried into the machine where it is held firmly in a stationary position while the seaming-head is forced in against the edge of the lid or can cover and revolved at a high rate of speed. The seaming head carries two seam-rollers of tool steel which are hardened and ground and mounted on roller bearings.

In the finishing machine, Fig. 1, a can is shown at *A* under the chuck. This can is being held up against the seaming chuck by the plunger-plate which is corrugated to prevent the can from turning. Directly above the third can from the right is the marking device. This attachment can be set with type to mark the ends with any impression desired. Just above the fourth can from the right is the magazine, which holds a stack of can ends. These ends are separated by the can as it passes through the can-guides and engages with an index-lever. The can-end passes along with, but just above, the can body until after the end comes from the marker, when it drops down in its place on the can.

Construction of Machine

The cans are carried from the filling machine on an endless belt, and are placed on a revolving table at the left-hand end of the seaming machine. This table moves them along until the dogs on the chain shown just under the table carry them under the plunger-plate, ready for the seaming operation. The seaming head is composed of an inner sleeve, which is a running fit in an outer sleeve. The outer sleeve runs on two tapered roller bearings. The inner sleeve is bored out to clear the chuck shaft which passes through the entire seaming head, and it has a bearing on the chuck shaft at one end. The chuck shaft is bored to clear the cam-operated knock-out, which forces the can from the chuck after the completion of the seaming operation.

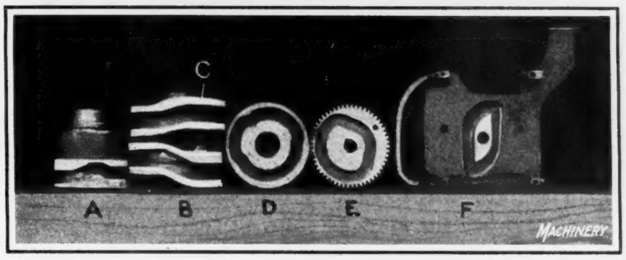


Fig. 2. Cams used in Machine shown in Fig. 1

The cam that operates the knock-out is shown at *A* Fig. 2. The plunger-plate is also

forced up by a grooved cam which is shown at *B*. At *C* is shown the topper cam, which is similar in design to the plunger cam. The seaming is done by a cast-iron cam *D*, which is provided with a hardened and ground tool-steel center. This cam is contained in the seaming head *B*, Fig. 1. The handwheel shown at *C* provides means of making vertical adjustments. The mold-carrier cam, which actuates the mechanism by means of which the can body is placed on the plunger-plate, is shown at *E*, Fig. 2. It will be noted that this cam is provided with gear teeth on its periphery. The making of this cam, as well as the others in Fig. 2, calls for fine machine work.

A different size magazine is required for each size of can handled by the machine. The machine is belt-driven, and power is transmitted through a large steel worm-gear. By the extensive use of jigs and fixtures in the manufacture of the various parts entering into the construction of this machine, the element of inaccuracy is reduced to a minimum. Special care is taken in the design and construction of the jigs and fixtures to provide for means of facilitating the handling and setting up of the work for the different machining operations. All parts that must be counted on to retain their shape are seasoned after the roughing cuts are taken. Particular care is taken in seasoning the casting of the cover feed-plate shown at *F*, as this part is required to be very accurate.

* * *

A lighting code for factories, mills, and other working places, based upon earlier codes issued by the Illuminating Engineering Society, and recently revised by a sectional committee under the sponsorship of this society, has been officially approved as standard by the American Engineering Standards Committee. The code is very brief, consisting of a few rules covering methods of avoiding glare, and the minimum requirements, from the point of view of safety, for exit and emergency lighting. Supplementary to the code are numerous suggestions relative to illumination for different classes of work and an outline of the advantages of good lighting.

GRINDING TRIMMING DIES USED IN SHOVEL MANUFACTURE

By C. F. GEORGE

The dies used in trimming round-point shovel blanks are usually made in two parts. The cutting members or blades are made from 3- by 3/4-inch shear steel, and they are fastened to cast-iron bolsters in the manner indicated in the enlarged sectional view in the lower right-hand corner of Fig. 1. This construction permits the bolster to be fitted to the bolster-plate *A* or to the upper die-plate *B* to suit the size of shovel to be trimmed. The shovels are usually made with a uniform variation of 1/2 inch between sizes on the width and length, unless otherwise specified, and the radius of curvature of the die blades for all shovel sizes is the same. By drilling a series of holes in the bolster-plate and upper die-plate, spaced to agree with the size of shovel being trimmed, adjustment for width will enable one set of die blades to be used on all standard sizes of shovels. The blades, which are forged to shape, are fastened by dowels and bolts to the bolster, as previously stated, and when assembled to their respective plates, have the general arrangement indicated in the sectional view *D*.

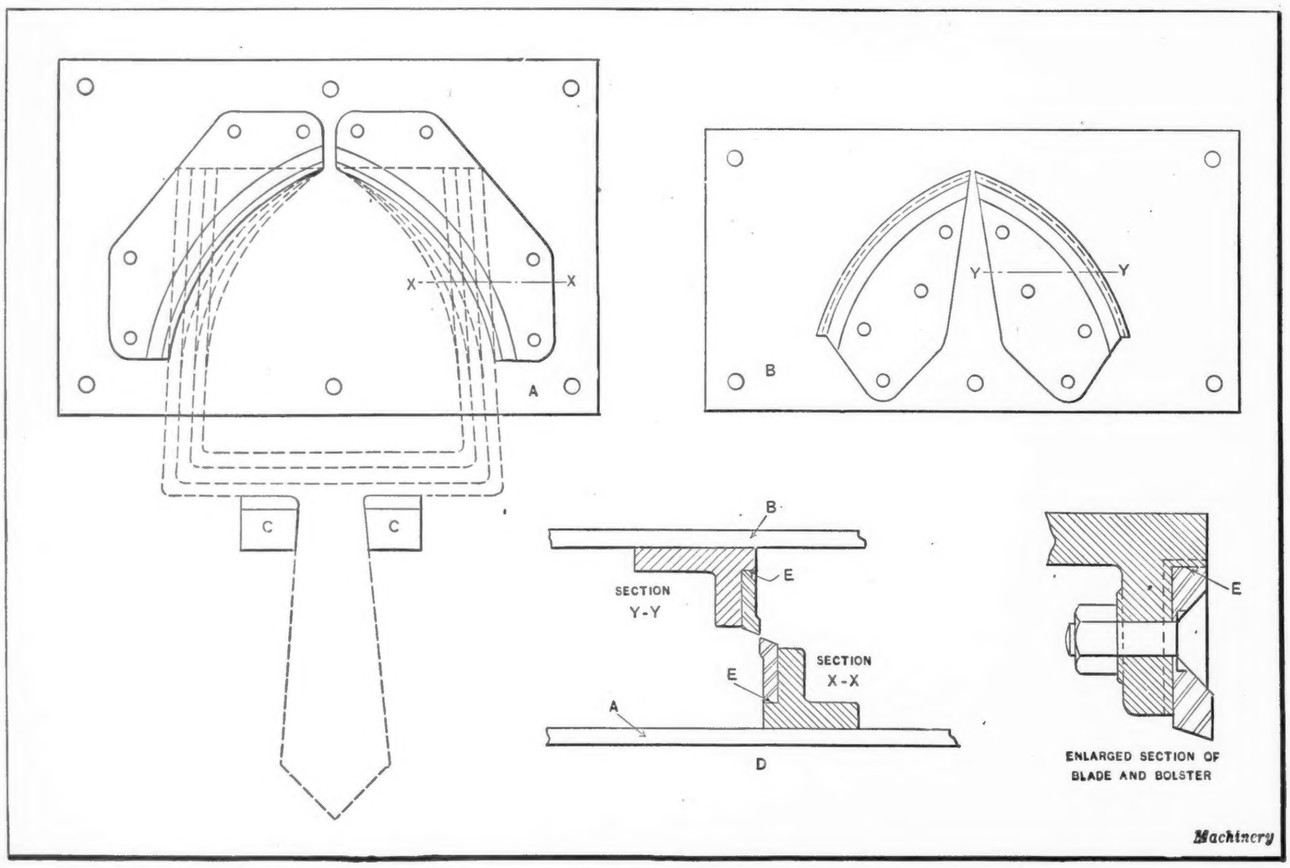


Fig. 1. Arrangement of Blades of Trimming Dies used in the Manufacture of Shovels

In assembling the bolsters to plates *A* and *B*, they are first ground to form a seat and then holes are drilled for the bolts by means of which they are attached to the plates. Surface *E* is also ground to form a seat for the blade, and bosses are cast on the plates for the bolt holes. These bosses are carefully filed to gage height, and provide an even support for the blades. This is an economical way of obtaining the desired fit, as it obviates finishing the entire bearing surface. The bottom dies are shown in the left-hand part of Fig. 1; in this view the relative contour of shovels of different sizes and the position which the blanks occupy during the trimming operation are indicated by dotted lines. It will be seen that the blanks are brought up against two stops *C*, the transverse adjustment for the bolster plate being obtained by means of the T-slots in the bed of the press. The upper die-plate *B* is attached to the ram, and it is in

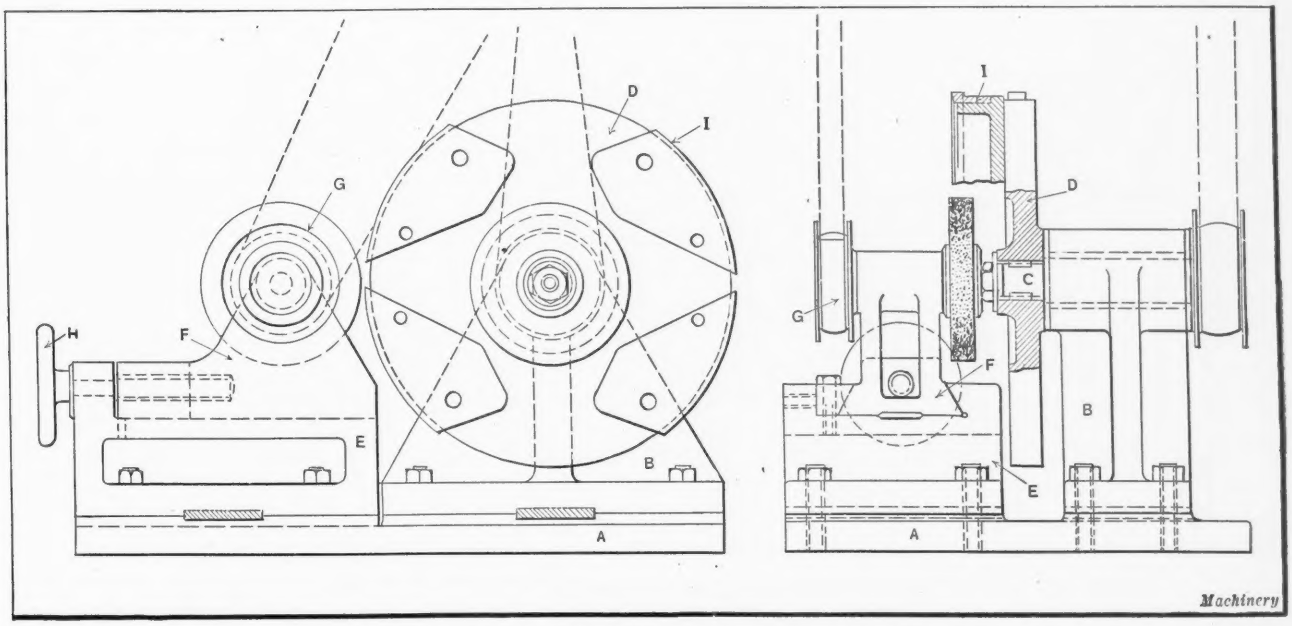


Fig. 2. Fixture for grinding Cutting Edges of Upper Die Blades

relation to the upper dies that the lower die-plate *A* is adjusted. After the upper and lower dies have been located on their respective plates by the holes for the particular size shovel to be trimmed, they are bolted down and tested on a bench, before being put into use. All the shear is put on the upper set of die blades which perform the trimming, the lower dies not being provided with shear.

Before being used, the bolsters and assembled blades are ground with the special grinding equipment shown in Figs. 2 and 3. The fixture for grinding the cutting edges of the upper die blades is illustrated in Fig. 2. This consists of a cast-iron base *A* to which is bolted the spindle bearing stand *B*. The upper part of this stand is the bearing box for the spindle *C* which carries the flanged driving pulley and the faceplate *D*. On the cast-iron base is also mounted the grinding wheel head, which consists of a cast-iron support *E*, in which the wheel-slide *F* is carried.

The slide casting contains the bearings for the short shaft that supports the pulley *G* at one end and the grinding wheel at the other. The blades *I* are bolted to the faceplate *D* by means of the bolsters to which they are fitted, slightly elongated bolt holes being used to allow for angular adjustment. After the bolsters and blades have been properly adjusted, the grinding wheel is traversed up to the face of the blades by operating the handwheel *H*. The uniform curvature of the cutting edges of the blades can thus be readily established and checked by the use of calipers. The grinding wheel is operated at a speed of 3000 revolutions per minute and the faceplate at 60 revolutions per minute in the opposite direction, both the wheel and the faceplate being driven by belts from the lineshaft.

The grinding fixture used in grinding the lower die blades is of equally simple construction, as shown in Fig. 3. It consists of a cast-iron base *A* to which the driving shaft bearing *B* is bolted. The driving shaft carries a flanged pulley by means of which the faceplate *C* is driven. The grinding wheel shaft is supported in roller bearings, mounted at each side of the driving pulley *D*, these bearings being housed in the top slide *E*. Slide *E* may be adjusted in the bottom slide *F* by means of a handwheel and traverse screw, a similar construction also being provided for the crosswise movement of slide *F*. Adjustable guide strips *G* are provided for the top slide, and a tapered gib *H* compensates for wear on the lower slide. The radial adjustment of the grinding wheel to obtain the correct curvature of the cutting edges of the blades is accomplished by operating handwheel *J*.

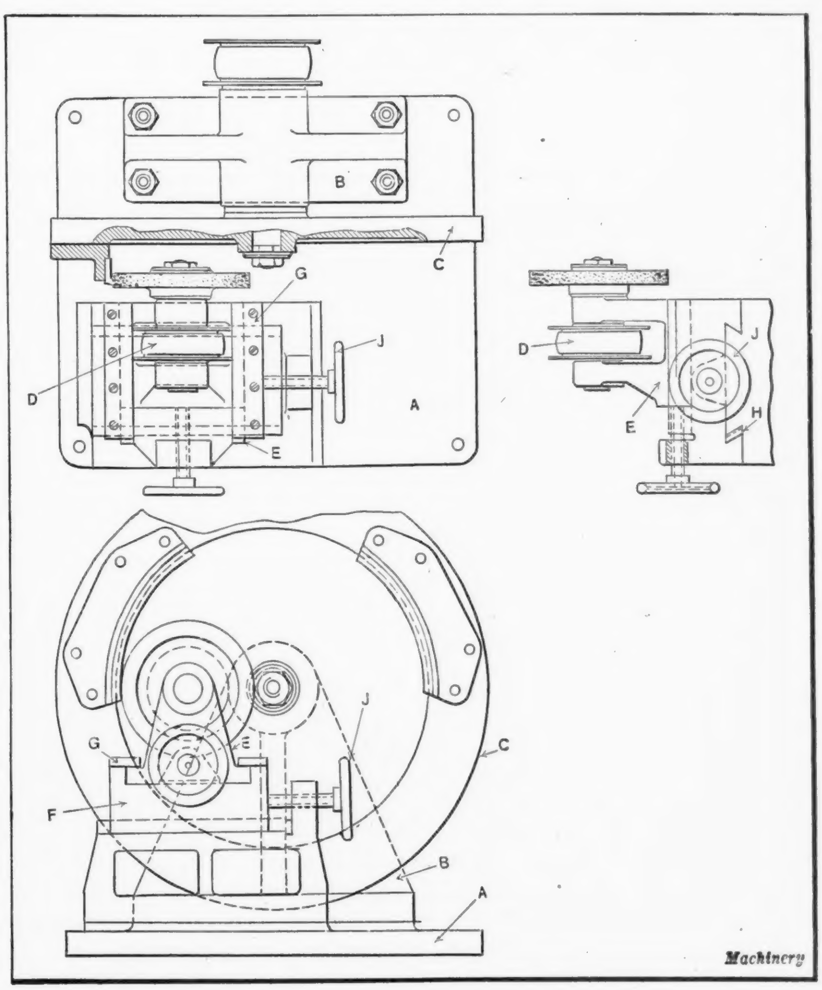


Fig. 3. Design of Fixture in which the Lower Die Blades are ground

As in the method of attaching the top blades, elongated holes in the faceplate allow for making angular adjustment when

attaching the bolsters and blades to the faceplate. This slight elongation is not shown in either Figs. 2 or 3. The inside diameter of the cutting edges of the bottom blades, when assembled to the faceplate, should be 0.010 inch greater than the outside diameter of the upper blades. This provides the necessary clearance between the dies when in use. The grinding wheel and the faceplate are driven from the line-shaft, and the same rotative speeds are used as are employed when grinding the upper blades. One set of trimming dies has produced 12,000 blanks before being reground. For average conditions it requires about one-half hour to set up and grind a pair of blades.

* * *

PATTERNS FOR CHECKED FLOOR-PLATE CASTINGS

By M. E. DUGGAN

Cast-iron stair treads and floor-plates are easy to keep clean and are very strong when properly supported. They are therefore used to a considerable extent in shops and factories. Pattern material for producing the checked surfaces that are required to prevent workmen from slipping on them can be obtained from companies that deal in patternmakers' supplies. Material of this kind usually has diamond-shaped checks cut in one side, although other designs are sometimes employed.

This stock is ordinarily obtainable in thicknesses ranging from 1/2 to 3/4 inch. In some cases patternmakers are required to cut and shape the diamond checks in patterns for stair treads or floor-plates. This is a slow and tedious job, however, and is seldom attempted when it is possible to obtain stock already provided with checks of the required size and shape. The following method of constructing a pattern for molding four checked floor-plates, *A*, *B*, *C*, and *D*, of the dimensions shown in Fig. 1 was recently observed by the writer in a jobbing shop.

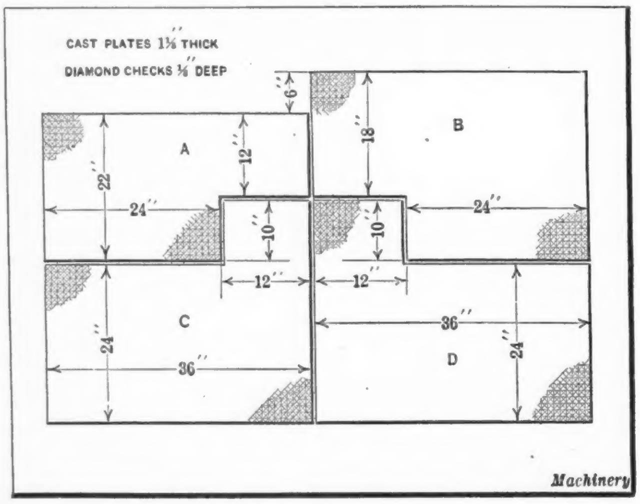


Fig. 1. Diamond-checked Floor-plates

Skeleton frames conforming to the outlines of plates *A* and *B*, and one frame for plates *C* and *D*, were made from 1- by 1 1/4-inch pine stock. One of these frames is shown at *E*, Fig. 2. In making the mold, the frame and drag flask are first placed in position on the bottom board. The space within the frame is filled in with boards 1 inch thick, or the thickness of the plate. These filler boards are furnished with the pattern and can be made from scrap lumber. It is not absolutely necessary that they be fitted tightly; all that is required is that they be flat and of uniform thickness. Sand is next filled in up to the top of the flask, and the mold made in the usual manner. The drag is then rolled over, the cope flask placed on it, and the cope mold completed, after which the cope flask is lifted off.

By placing the loose pieces within the frame, the latter is practically converted into a one-piece pattern so that no digging out or disturbing of the mold is necessary. A better casting is produced from a mold made in this way than would be the case if no filler boards were used and the "digging-out" method employed. After the cope has been lifted out the filler pieces are removed, leaving the frame in the mold. The diamond checks are then made in the bottom face of the mold. First a block of wood *F*, Fig. 2, is cut and finished to a convenient size (in this case 6 by 12 by 1 1/8 inches). Diamond checks are then cut in one face of this block. The block is next fastened to the gage-board *G*. The ends of this board are made long enough to overlap the drag flask in order to allow the block to be shifted back and forth over the frame. In the illustration the gage-board *G*, with the block *F* attached to it, is shown in position for making the first impression of the diamond checks in the face of the mold. A few taps with a hammer on the gage-board is sufficient to make the required impression. The block is next moved to the opposite side within the frame and another impression made. This process is continued until the whole face of the mold within the frame has been given the impression of the diamond checks.

Only one frame is required for plates *C* and *D*, as it is only necessary to reverse the position of the frame on the bottom board when making the mold for a plate of the opposite hand. Before moving the diamond-checked block ahead, a mark is made on the frame and the opposite edge of the gage-board then brought flush with this mark. If the work is properly carried out, the face of the casting will appear as if made from a full pattern. This method, of course, adds to the work of molding, but results in a saving in material and time, as it does not require the making of a full pattern. Another advantage is that there is no large plate pattern to be handled or stored away in the pattern loft where it is likely to become warped and twisted. It may be mentioned that the thickness of the frame is the same as the thickness of the cast plate minus the depth of the diamond checks. In this case the cast plate is 1 1/8 inches thick, the diamond checks 1/8 inch deep, and the frame 1 inch thick.

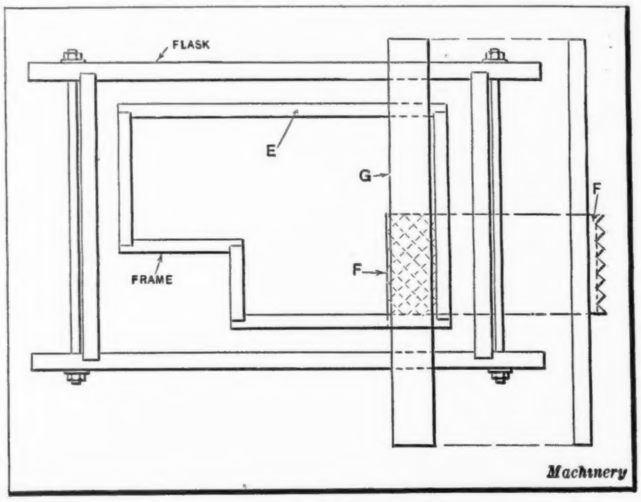


Fig. 2. Patterns for Floor-plate Mold

* * *

THE COST OF BUILDING

The Bureau of Labor Statistics, Washington, D. C., has published a chart and a tabulated statement showing the increases in wages in the building trades and in the price of building materials since 1913. This statement shows that at the present time the average wages in all of the building trades combined are almost exactly double what they were in 1913, and the average of all building materials shows an increase of about 55 per cent over the 1913 figures. Brick has been reduced the least from the peak prices, prices of common brick being still double the 1913 prices. The average price of lumber is 65 per cent above the 1913 figure.

Checking the Accuracy of Lead-Screws

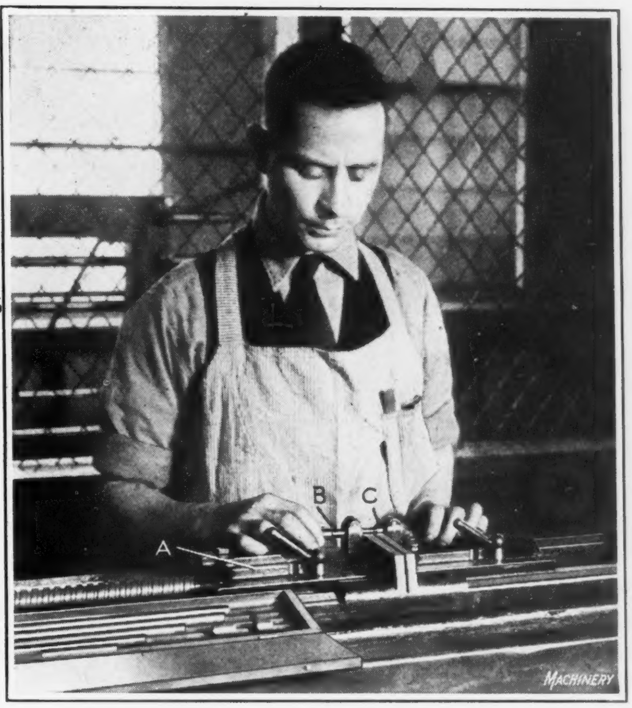


Fig. 1. Adjustment of Micrometer Spindle and Anvil Preparatory to checking Lead-screw for Lead Errors

When lead-screws are checked for accuracy at the plant of the Pratt & Whitney Co., Hartford, Conn., the test is based on the action of a nut relative to the screw, or the distance that the nut moves for a given rotation of the screw, as compared with the movement that would be obtained if the screw were perfect in lead. This simple method of using a nut and basing tests upon its movements is employed instead of attempting to determine the accuracy by a series of local tests along the screw itself, because, after all, it is the movement imparted to the nut that is important when the screw is applied to a lathe or other machine.

The testing fixture used for lathe lead-screws is very simple, as Figs. 1 and 2 indicate. There is a rigid bed long enough for any of the screws manufactured. This bed has accurate ways, and a block *A* which is free to slide along the ways and which carries a nut conforming to the diameter and pitch of the lead-screw to be tested. The nut can be replaced readily by others of different size and pitch when lead-screws of different sizes are to be tested. The sliding block carrying the nut also carries a micrometer head *B* which is opposite an anvil *C* held in another block mounted on the ways. The latter block may be shifted along the bed to whatever section of the lead-screw is being tested, but it is clamped in position for taking measurements. At one end of the lead-screw there is an index-plate *D* (Fig. 2) which provides for turning the screw exactly one revolution, or any whole number of revolutions.

In checking the accuracy of an ordinary lead-screw, the errors per foot are determined by the following method: The fixed anvil and the adjustable micrometer head are placed at one end of the lead-screw, and the micrometer spindle is adjusted to make contact with the anvil, as shown in Fig. 1. Next the lead-screw is revolved as many times as is necessary to move the engaging nut one foot, the number of turns depending, of course, upon the lead of the thread. The distance that the micrometer spindle has moved from the fixed anvil is then checked by using a standard end-measuring gage, as shown in Fig. 2. Whatever error there may be is readily determined by means of the micrometer. To secure greater refinement, as when checking the accuracy of screws that are more nearly in the precision class than ordinary lead-screws, standard gage-blocks are used in conjunction with a dial indicator, for taking the measure-

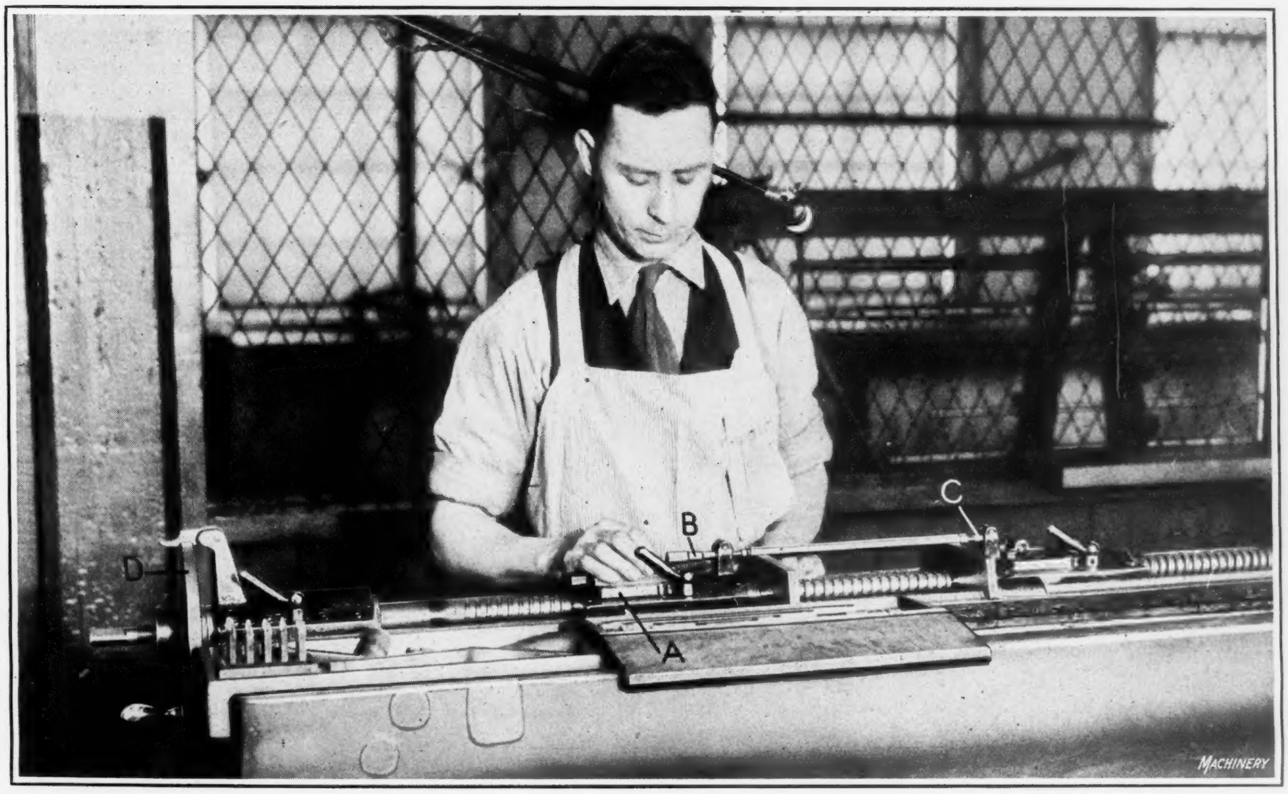


Fig. 2. Standard End-measuring Gage inserted between Anvil and Micrometer Spindle to show Lead Errors

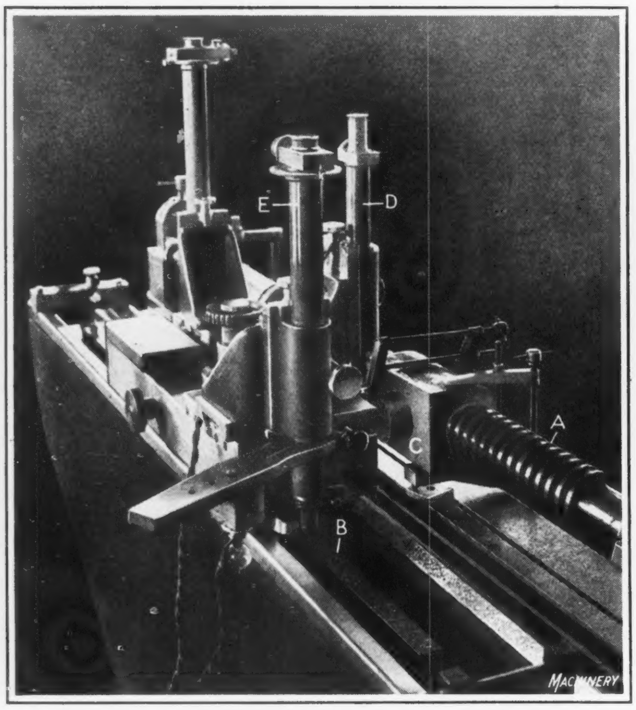


Fig. 3. Arrangement for testing Precision Screw by Direct Comparison with the Standard Bar of a Measuring Machine

ments, instead of an ordinary micrometer head and end-measuring gage.

Another method that has been employed when a very precise test is required is to check the accuracy of the screw by comparison with the standard bar of a precision graduating machine. Fig. 3 shows the machine equipped for this purpose. While this is a makeshift arrangement, any slight lead error in the screw may be readily determined in this way. The precision screw at *A* is compared with the standard bar at *B*. A small angle-plate carrying a polished plug, on which there is a very fine line, is clamped to the nut *C*. This plug is just beneath the microscope *D*, and it is a duplicate of the plugs inserted in measuring bar *B*. An index-plate is mounted on the end of the screw *A* to be tested. After adjusting nut *C* very carefully until it is square with the machine, microscope *D* is located over the plug attached to the nut, and microscope *E* is brought into position over one of the plugs in the measuring bar. The screw is then rotated a predetermined amount, after which the nut is again set square. The carriage carrying microscope *D* is also moved until the microscope is in alignment with the plug on the nut. Microscope *E* should then be in alignment with a plug on the measuring bar. If it is not, the difference is measured by the slide in the microscope, and this difference represents the error in the part of the screw that has been tested.

* * *

SETTING LATHE FOR TURNING TAPERS

By DUNCAN CAMPBELL

The method of setting a lathe for taper-turning operations described in the following has been used by the writer for several years. It has proved especially useful in boring the tapered holes in propellers and in turning the tapers on tail-shafts when fitting them to propellers. As an example of the application of this method, assume that it is required to bore out a tapered hole in a propeller and turn up the taper on a tail-shaft to fit the tapered hole in the propeller, the taper being 1 inch to the foot.

To set the compound rest to the proper angle for boring the tapered hole in the propeller, first scribe a circle on the face of the chuck or faceplate having a diameter of, say, 2 inches. Next scribe another circle with a diameter equal to that of the first circle plus one-half the taper per foot desired—or in this case, $2 + \frac{1}{2} = 2\frac{1}{2}$ inches. Two lines are next scribed on the upper and lower slide members of the compound rest at points *A* and *B*, as shown in the illustration. Now if it is simply a problem of boring a tapered hole in the propeller and turning the taper on the shaft to fit the hole, we can make the distance *C* between the two scribed lines *A* and *B* equal to 6 inches. However, if it is required that the taper be exactly 1 inch to the foot, it is necessary (theoretically at least) to make this dimension slightly greater than 6 inches. To be exact, the distance should be:

$$C = \sqrt{0.25^2 + 6^2} = 6.0052 \text{ inches}$$

It will be seen from this formula that for practical purposes dimension *C* in this instance can be taken as 6 inches. However, if the method is used for very steep tapers or if it is necessary that the taper be exact, it will be necessary to calculate *C* by the formula

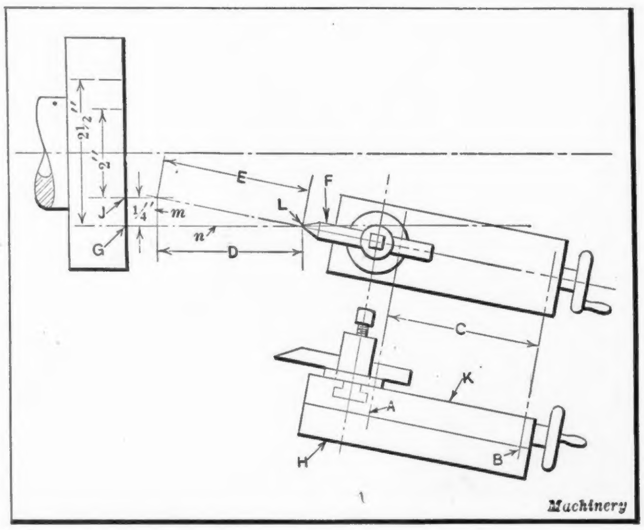
$$C = \sqrt{m^2 + n^2}$$

in which m equals one-half the difference between the diameters of the scribed circles on the faceplate and n equals 6 inches. The diameter of the larger circle scribed on the faceplate must, of course, equal the diameter of the smaller circle plus one-half the taper per foot desired, as previously stated.

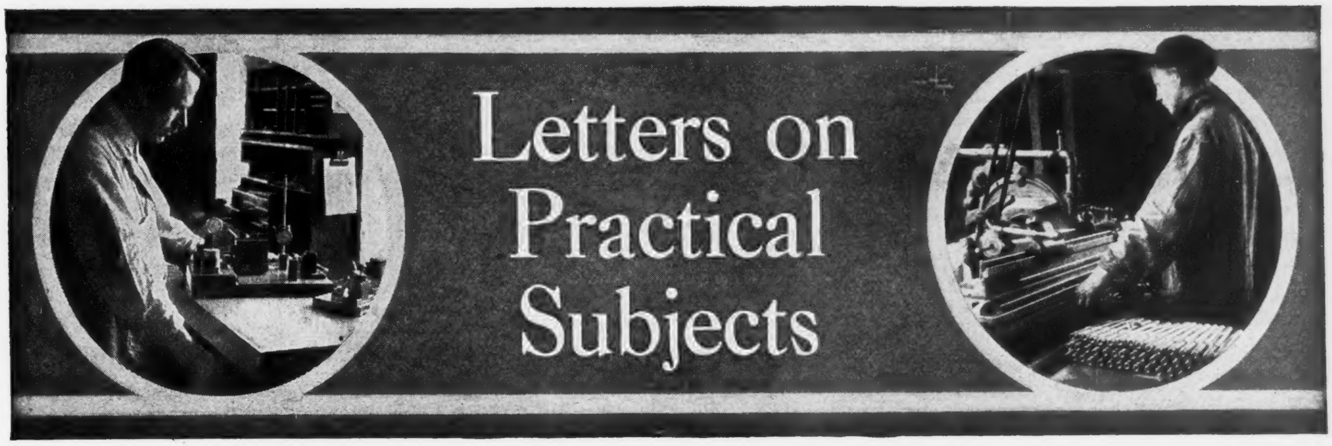
Next set the compound rest as nearly as possible to the proper angle for turning the required taper, and advance the carriage of the lathe until the point of a file or some other pointed instrument *F* comes in contact with the 2-inch circle at *J*. It is obvious that the point of *F* and the cutting point of the boring tool must be so set as to be at the same height as the center of the chuck or faceplate. Next adjust the upper slide member of the compound rest so that line *A* on the slide will be in line with line *B* on the lower member or slide base *H*. If the carriage is now brought forward and the point of *F* makes contact with the $2\frac{1}{2}$-inch circle at *G* it is evident that the slide is set at the proper angle for boring the hole. If this condition should not obtain, the angular position of the compound slide should be changed slightly until the required setting has been obtained.

Referring to the illustration, it will be clear that if *D* equals 6 inches and one-half the difference of the scribed circles equals $\frac{1}{4}$ inch, in order to turn a taper of 1 inch to the foot, slide *K* must advance a distance equal to dimension *E* from point *L* to make contact with the faceplate at *J* when the carriage is advanced. It is also clear that dimension *E* equals $\sqrt{m^2 \times n^2}$.

In turning the taper on the tail-shaft a 12-inch scale is clamped to the tailstock at right angles to the tailstock spindle and the graduations on the scale are used in the same manner as the circles scribed on the faceplate to determine the proper angular setting of the compound slide.



Method of setting Compound Rest for Taper Turning



CONVENIENT STOCK RECORDER

Inside every automobile speedometer there are two mileage registering units, one with three rows of figures and one with six. Speedometers are usually discarded because of some failure in the transmitting member, while the instrument itself is good for the life of several cars. The discarded speedometers may be obtained at garages and from junk dealers for a trifle and turned into useful shop appliances.

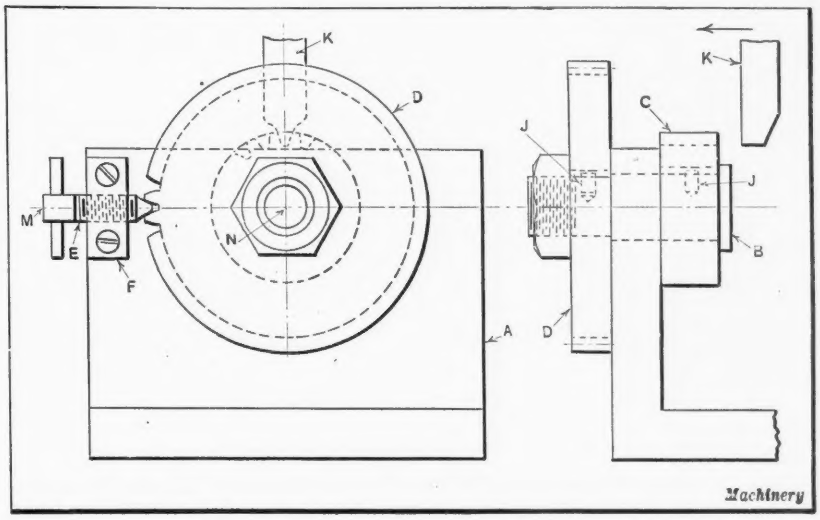
Records of incoming supplies, shipments going out, stock bins on which a perpetual inventory is kept, and inventory work in general all require the addition or subtraction of small numbers. When cards are used for this purpose, they become soiled and illegible. The mileage registering units from speedometers afford a convenient method of meeting these inventory requirements. The dials can be quickly turned to any number without becoming smirched by greasy fingers, and it is not necessary for the workman to use pencil and paper. It is a fundamental of tool design to reduce the number of "loose pieces" to a minimum; as applied to a stock bin with a perpetual inventory, this would mean that a registering unit should be attached to each bin.

There are, of course, various counters on the market (all operating the same as the mileage recording units of the speedometer) but they are larger and more expensive. The small or "trip" recording unit from a speedometer is particularly well suited for stock recording, and is so designed that it can readily be attached to any convenient post or to the wall.

Middletown, N. Y. DONALD A. HAMPSON

CUTTING GEARS WITH A SHAPER

A small pinion was required for a quick-repair job, and as there was no milling machine or gear-cutting machine available, it became necessary to provide some means of cutting the pinion teeth on a shaper. The way in which this was accomplished is described in the following. An angle-plate *A* was bored to receive the stud or shaft *B* on which the pinion blank *C* was mounted. A 40-tooth gear *D* belonging to a set of lathe change-gears was employed as an index-plate, and mounted on one end of shaft *B* as shown.



Fixture used in cutting Pinion Teeth on a Shaper

The end of index-pin *E* was turned to a conical shape and threaded to fit nut *F* at one setting in a lathe chuck. Nut *F* was attached to angle-plate *A* in such a position that it brought pin *E* into alignment with the center of shaft *B* on the line *MN*.

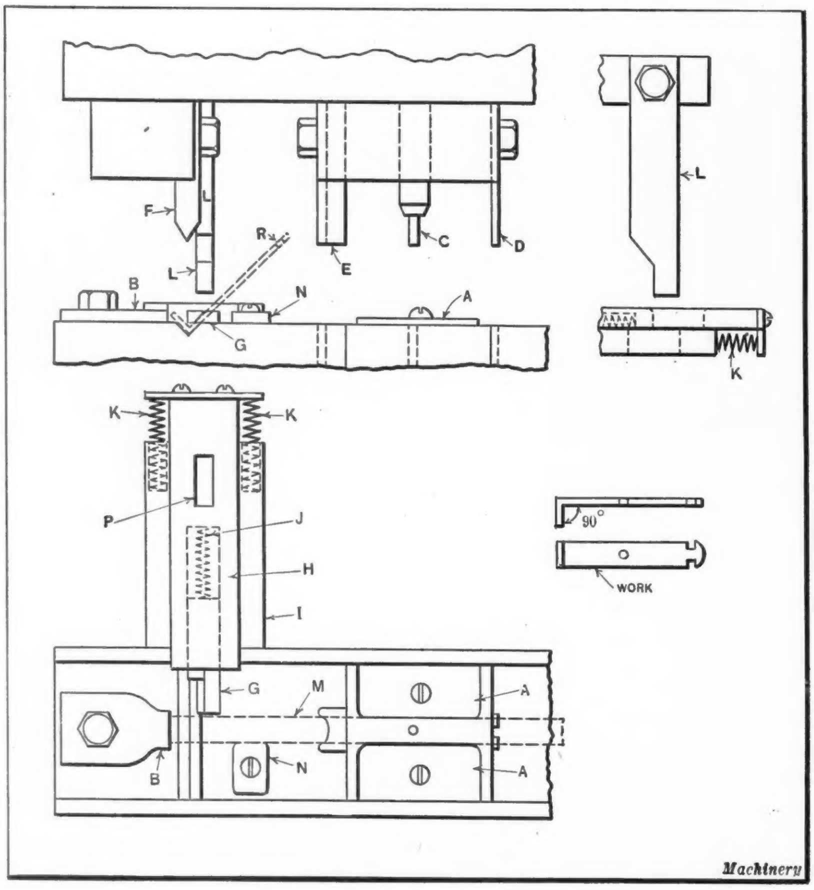
Gear *D* was indexed two teeth after each tooth space had been cut to depth, in order to obtain the correct spacing for the 20-tooth pinion being cut. The pins *J* in shaft *B* kept gear *D* and the pinion blank *C* in alignment. These pins were made a tight fit in the keyseats cut in the members that they held in alignment. The profile of tool *K* was ground to the correct form by using the teeth in the unbroken part of the original pinion as a gage or templet. The teeth were roughed nearly to size with a narrow tool before using the formed tool *K* for the finishing cut. The depth of the cut was determined by means of the graduated collar on the vertical feed-screw. The direction of the cutting stroke is indicated in the illustration by an arrow. A device similar to the one described was later used successfully in cutting ratchet teeth.

Algona, Iowa GEORGE WILSON

KNOCK-OUT FOR PUNCH-PRESS DIE

The accompanying illustration shows the construction of a punch-press die equipped with a knock-out mechanism. In the upper left-hand corner is shown a front elevation of the punch and die, while directly below is a plan view of the die. A side view of bar *L* which actuates the knock-out mechanism is shown in the upper right-hand corner. The work is formed from soft iron stock 0.250 inch wide by 0.060 inch thick. The stock is fed from the right-hand side of the die, between the guide plates *A* and against the stop *B*. When the ram descends, the stock is pierced by the punches *C* and *D* and cut off by the punch *E* while the 90-degree bend is formed by the punch *F*. As the ram ascends, the work is thrown out by the knock-out plunger *G*.

The interesting point in this die is the knock-out mechanism, which is shown with the ram in its extreme upper position. The knock-out plunger *G* slides in another plunger *H*. Plunger *H*, in turn, slides in a groove in an angle-piece *I* which is carried on the back of the die-bolster.



Punch-press Die equipped with a Knock-out Mechanism

Plunger G is held in its extreme forward position by the spring J, while plunger H is held in its extreme backward position by the springs K. Each of these plungers carries a stop-pin (not shown) which limits its motion. The bar L has a cam action on the downward stroke, imparting the necessary motion to plunger H by passing through the oblong hole P. The dotted lines at M show the position of the stock when the punch begins its descent. It will be seen by referring to the illustration that plunger G is so located that it just clears the edge of the stock.

When the ram has descended until the forming punch F comes into contact with the stock M, the punches E, C, and D will have just passed through the stock. The cam surface of the bar L, in its downward travel engages the forward edge of the oblong hole in the plunger H, causing it to move forward a distance equal to the throw of the cam surface. As plunger G is also carried on plunger H, it also has a tendency to move forward, but is prevented from doing so by coming into contact with the edge of the stock M, as shown.

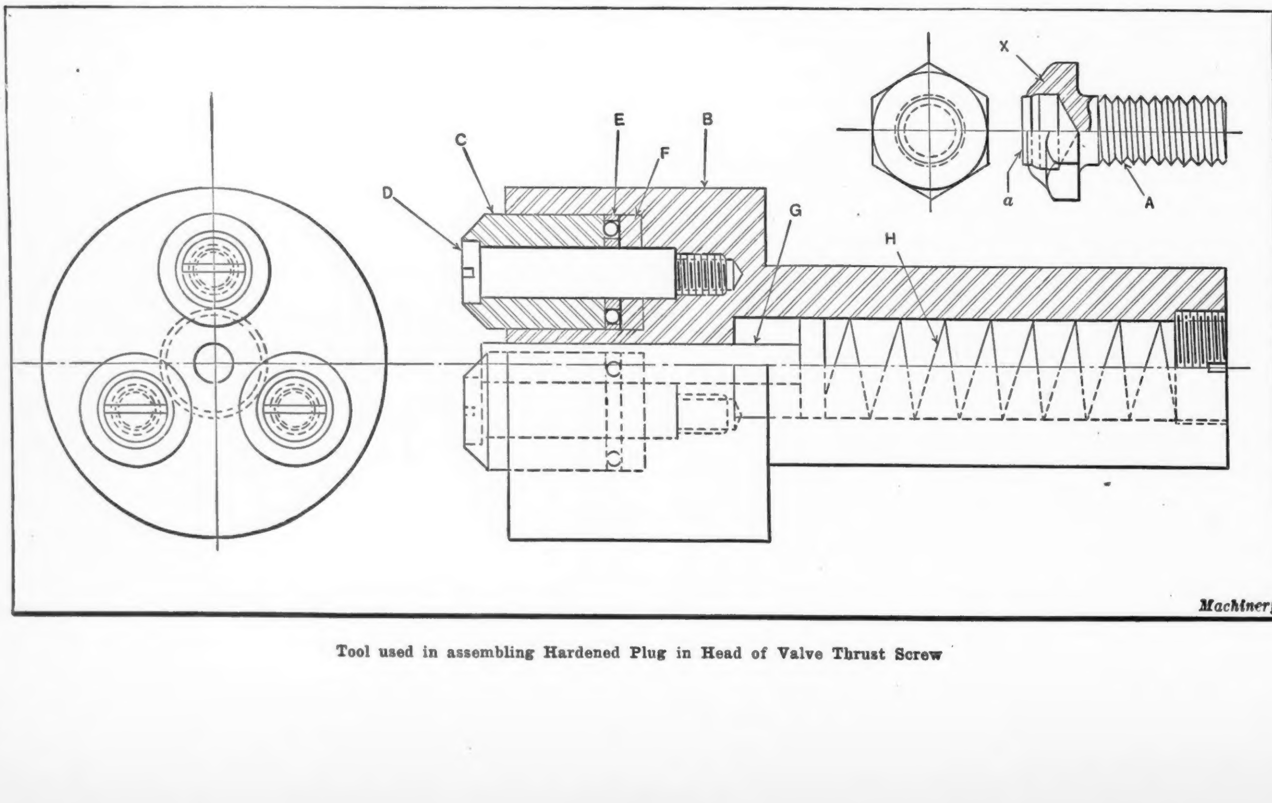
The stock M is held in position by the guide plates A and the stop N. In this position, the spring J is compressed, and pressure is exerted on the stock through the plunger G. Continued downward travel of the ram brings the forming punch F into operation, with the result that the stock is raised on one end so that it clears the stop N, as shown by the dotted lines at R, and is bent to the shape indicated. The pressure of the forming punch F on the stock is sufficient to overcome the action of the spring plunger G on the edge of the stock.

As soon as the ram starts on its return stroke, the pressure of the punch F on the stock is released, and the spring J actuates the plunger G, throwing the work clear of the die. The springs K then return the plunger H to its original position. When the press is running at a speed of 150 revolutions per minute, which is the speed regularly employed with this die, the work is thrown clear of the press bed, and into a hopper placed in a convenient position to receive it.

Philadelphia, Pa. R. H. Kasper

ROLLING TOOL FOR ASSEMBLING PLUG IN SCREW HEAD

The valve thrust screw shown at A has a hardened steel tapered plug a inserted in a drilled hole in its head, where it is held in place by peening or riveting over the edge X of the screw. This riveting operation was originally accomplished by means of a rivet-set and hammer, but the heavy blows necessary cracked many of the hardened plugs, thus causing the entire piece to be scrapped. To overcome this



Tool used in assembling Hardened Plug in Head of Valve Thrust Screw

difficulty, the tool shown was devised which rolls the metal instead of striking it.

The tool consists of a machine steel body *B*, turned to fit the machine at one end and bored to receive the three hardened tool steel rollers *C* in the other end. The rollers *C* are held in place by screws *D*, and the feed thrust on the rollers is taken care of by three small ball thrust bearings *E* which, in turn, transmit the thrust to the hardened washers *F*. A plunger *G*, actuated by spring *H*, holds the valve thrust plug *a* in place while rolling over the edge *X*.

The tool operates as follows: After the valve thrust screw and plug are chucked, the machine is started and the tool fed down on the screw. The plunger *G* strikes the plug and holds it in position before the rollers *C* begin to operate. As the tool is fed farther the rollers strike the edge *X*, and roll it down, thus completing the operation. The chamfer on the ends of the rollers *C* in this case was made 45 degrees.

Chicago, Ill. HAROLD A. PETERS

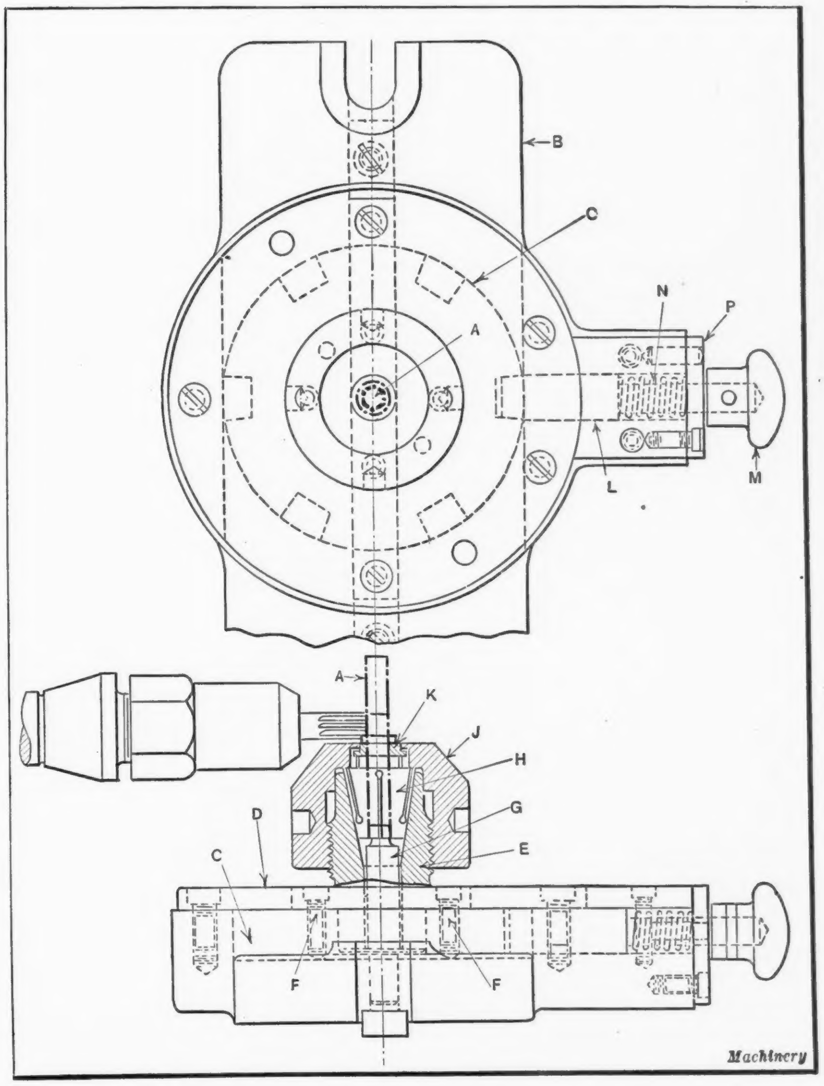


Fig. 1. Indexing Fixture for milling Hexagonal Section

INDEXING FIXTURES FOR HAND MILLING MACHINE

An indexing fixture for use on a hand milling machine is shown in Fig. 1. This fixture is provided with a vertical chuck designed to hold the work shown by dot-and-dash lines at *A*, which is required to have flats milled on six sides to form a hexagonal section as illustrated in the plan view.

The base *B* of the fixture carries the index-plate *C* which is retained by the plate *D*. The spindle nose *E* is a separate piece and is fastened to the index-plate *C* by means of screws *F*. The spindle nose carries the work-locating stop-pin *G*. The spring collet *H* clamps the work in place when cap *J* is screwed down on the washer *K*. The indexing plunger *L* is provided with a knob *M* and is forced into the slightly tapered indexing slots by the action of spring *N*. Spring *N* is retained in place by a plate *P* which is fastened to the plunger base as illustrated.

The indexing fixture shown in Fig. 2 is for milling cross-slots in the head of the bolt shown by heavy dot-and-dash lines at *A*. This fixture is similar in design to the one illustrated in Fig. 1. The index-plunger in this case, however, enters indexing holes in the spindle, and therefore requires no additional index-plate.

Waynesboro, Pa. D. A. NEVIN

FORMING DIE AND ANGULAR SHEARING PUNCH

A die of rather unusual construction containing a forming punch and die, in combination with a shear punch, and mechanism for operating it is shown in Fig. 1. This die is used on a press having a so-called "double action," inasmuch

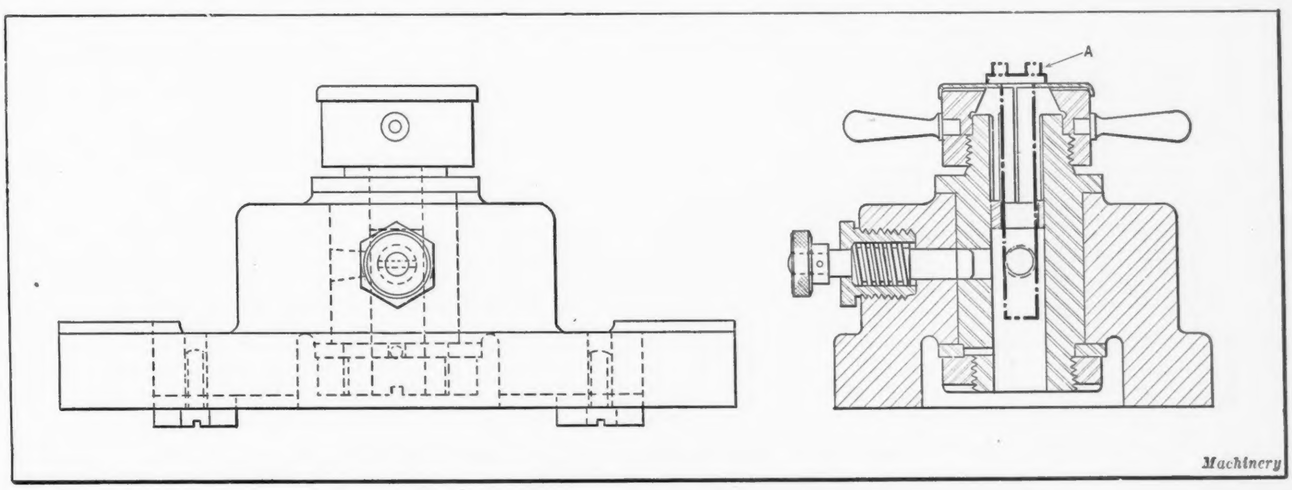


Fig. 2. Fixture used in milling Cross-slots in Bolt Head

as the forming punch must come down and form the work, after which it dwells while the shearing punch is operated. A detail view of the work is shown at the left. Fig. 2 shows some of the details used in the construction of this die; the same reference letters are used for these parts as in Fig. 1.

Referring to Fig. 1, the forming punch *A* is held in place in holder *B* by set-screw *C*. A screw *D* with a brass shoe in front of it prevents screw *C* from working loose under the continual jar of the press. At *E* is an adjustable punch against which the formed part is sheared when the die is in the closed position. This punch is backed up by the screw shown at *F*.

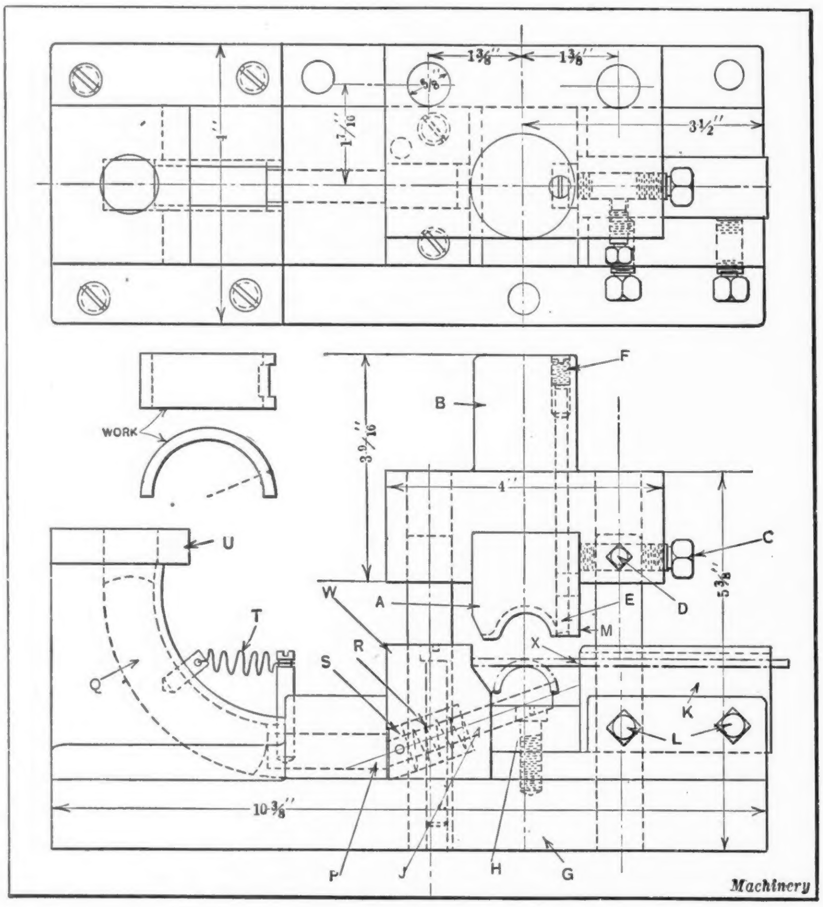


Fig. 1. Forming Die equipped with Angular Shearing Punch

The die over which the work is formed is contained in a cast-iron die bed *G*, the formed die being illustrated at *H*, and the shearing punch at *J*. Screws hold the formed die in place as shown. At *K* is a steel block held in place by two screws *L*. On the top of this block is a stripper plate, the stock from which the work is made being fed through a cut-out or slot in this plate. The stock is cut by the punch *M* as it descends, being sheared at point *X*.

As the forming punch descends the work is bent over the forming die and is held there while shearing punch *J*, through the medium of plunger *P* is forced out by the rocker *Q*. Rocker *Q* is pushed down by a lever at the side of the press, which is operated by an eccentric. In this connection it should be borne in mind that the press is of the cam-operated type, which allows the forming punch to dwell a short time while the shearing punch is operated by the eccentric. The spring *R* keeps the shearing punch back by acting against the collar *S* which is pinned to the punch. The spring *T* keeps the rocker and intermediate piece in contact with the operating lever which has but a slight action and is guided in block *U*.

This die proved an economical means of handling the work, as the diagonal shearing is an operation which would take much time if performed separately. F. Server

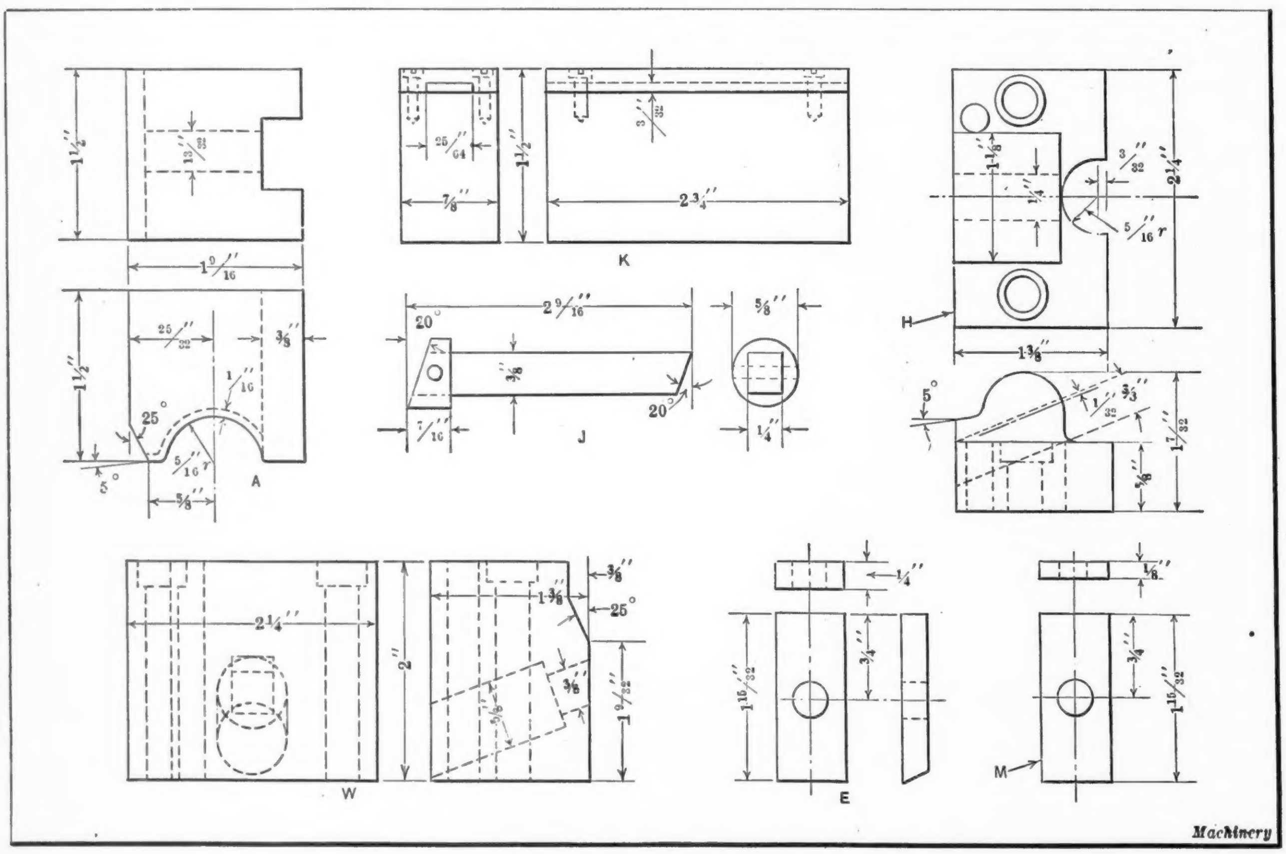


Fig. 2. Details of the Shearing Punch illustrated in Fig. 1

SLOTTING FIXTURE FOR COMMUTATOR SEGMENTS

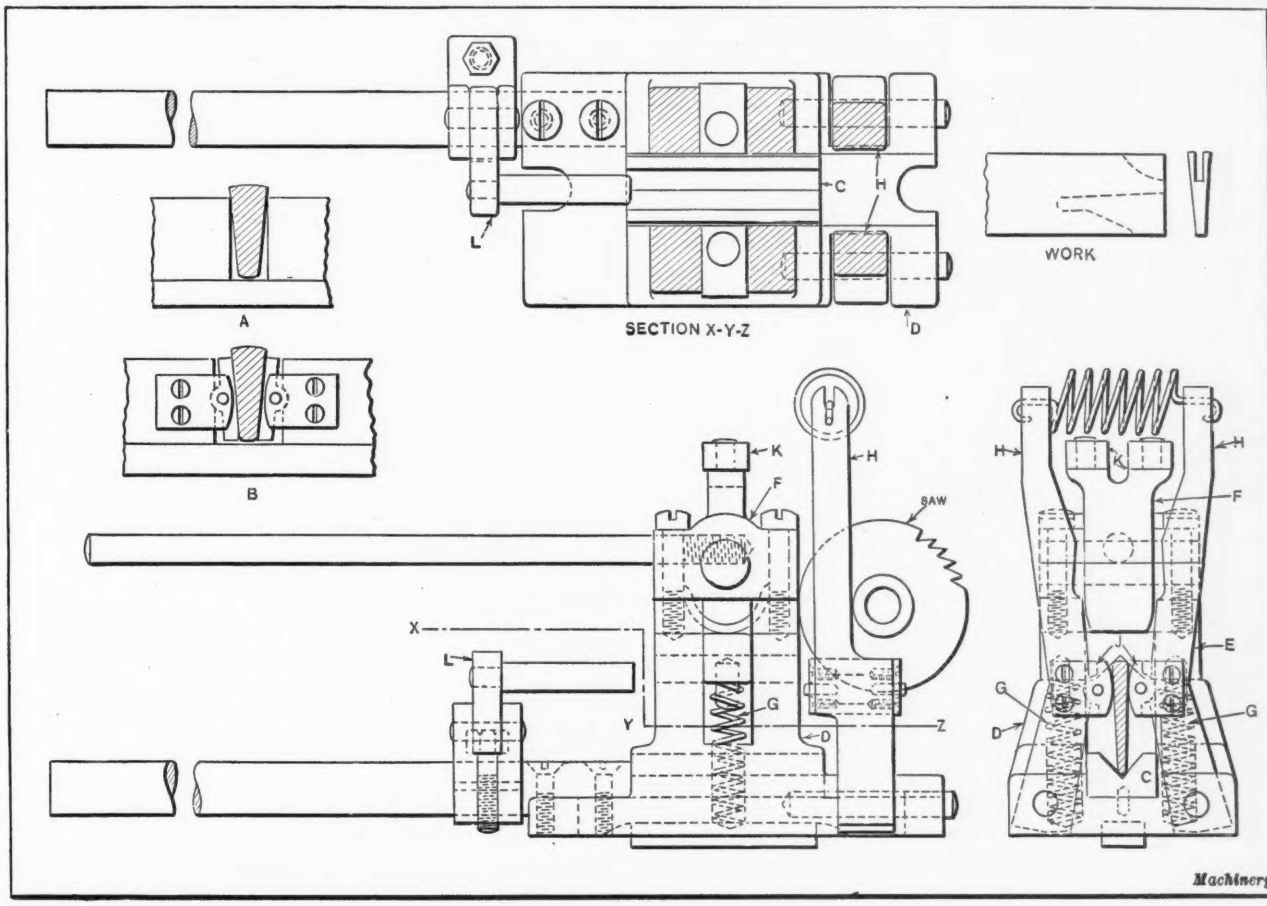
The copper bars or segments in a commutator are slotted at one end to accommodate the leads used in soldering the armature windings. The detail view in the upper right-hand corner of the accompanying illustration clearly shows the construction. Ordinary milling machine vises are usually employed for holding the work while slotting, but these require a lot of adjustment to suit the great variety of widths and sectional shapes that have to be handled.

The varying angularity of these wedge-shaped sections makes it inadvisable to construct tapered vise jaws to conform to each change in shape, and so ordinary straight jaws are extensively used. These jaws pinch the bars in the manner indicated at *A*, causing them to be indented. An excessive amount of pressure is required to keep the bars in place by the use of jaws of this type, so that often the vises break or the threads in the nuts are stripped from the continuous tightening of the crank-handle. Not only is this means of holding unsatisfactory, but it is also a laborious task to perform the work by the use of a vise of this kind. Adjustable jaws like those illustrated at *B* may be used on milling machine vises, but these have a tendency to pinch the work and cause the sides of the slot to bind on the saw.

Owing to the objections to the use of milling machine vises equipped with either standard or adjustable jaws, a special fixture was designed for clamping these segments, the construction of which is shown in the illustration. This consists of a cast-iron base *D* which is attached to the table of a bench milling machine, and which carries the clamping arrangement. Its advantage is that it can accommodate various sizes of segments and that it is quick-acting. The position of the work is indicated in section in the end view, from which it will be seen that the bars are located vertically and clamped between two V-blocks, *C* at the bottom and *E* at the top. Block *C* is a stationary member located in a slot in the base, while the upper V-block *E* exerts pressure on the top of the work through an eccentric cam *F*, which is operated by a long lever. The base has a wide slot to accommodate this cam, and it is supported by trunnions and held in place by bearing caps.

The under side of V-block *E* carries two pins, which anchor the top ends of the two coil springs *G*, located in the base of the fixture. The purpose of these two springs is to exert pressure against the top V-block, keeping it in contact with the cam. Provision is made in this clamping device for exerting a light pressure on the work while the slot is being cut, thus preventing the walls from spreading, which is quite likely to occur, especially on thin bars. For this purpose two levers *H* carry a pair of swivel jaws *J* at their lower ends. The pressure of these jaws on the work is removed as soon as the clamping mechanism is released, by means of the same cam *F* used for clamping. In releasing the upper V-block by means of the long lever, cam *F* is revolved so that the rollers *K* operate against the lower surfaces of the levers *H* and force them apart. These rollers are integral parts of the cam.

The weight of the long lever by means of which the cam is operated is sufficient to exert clamping pressure enough to hold the bars rigidly during the slotting process. Segments of various sizes can be handled in this fixture without requiring adjustment and with the assurance that they will be located centrally and vertically. When heavy bars are being slotted, the compression spring connecting the side levers *H*, by means of which the pressure is exerted against the bars, may be removed and the levers omitted. When bars of varying widths are to be slotted, V-block *C* may be shimmed up if necessary. An adjustable stop with a pivot arm *L* is employed to suit varying lengths of bars. This arm may be easily swung back so that the bars can be inserted without interference. This device has been in constant use for two years, and as a result of the speed with which it can be operated the cost of machining the segments has been considerably reduced.



Quick-acting Clamping Device for Holding Commutator Bars

East Orange, N. J. JOHN E. UNGER

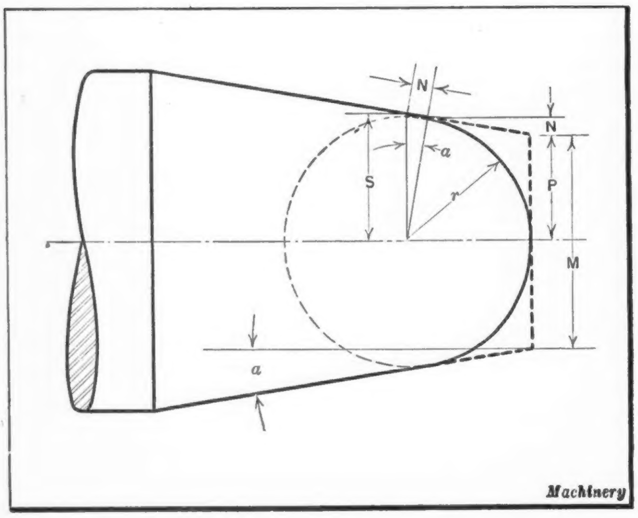


Diagram for finding Diameter at End of Tapered Rod

DETERMINING THE DIAMETER AT THE END OF A TAPERED ROD

When the tapered end of a rod has been machined to a semi-spherical form, as shown in the accompanying illustration, it is sometimes desirable to determine the original diameter M at the end of the rod. The following solution to this problem may be of interest to tool designers and toolmakers. Referring to the accompanying illustration, the known dimensions are:

a = angle of taper at end of rod; and

r = radius at rounded end.

With these values known, it is required to find M, or in other words, to find the original diameter at the end of the piece before forming. Now by trigonometry,

$$N = r \tan a \quad \text{and} \quad S = r \sec a$$

$$P = S - N$$

Substituting,

$$P = r \sec a - r \tan a = r (\sec a - \tan a)$$

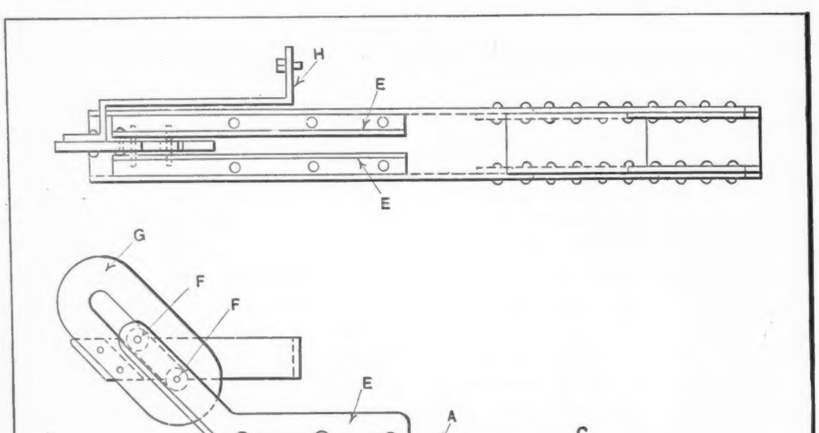
Then

$$M = 2P = 2r (\sec a - \tan a)$$

Flint, Mich. W. G. HOLMES

GUARD FOR CIRCULAR SAW

A guard for a power-fed circular saw that will cover both the saw and the feed-wheels properly is shown in the accompanying illustration. It consists of a hood or guard A and a nose-piece B, both of which are made of heavy sheet-iron stock. The two sides and the top are in one piece with the division plates C and D, which are riveted to the sides as shown.



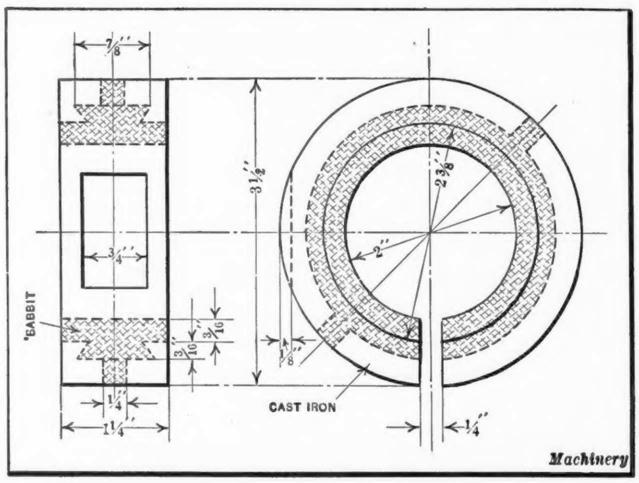
Guard for Circular Saw

The angle-irons E are equipped with anti-friction rollers F, which fit loosely in a slot in plate G. Plate G is fastened to the bar H, which, in turn, is bolted to the frame that carries the feed-rolls. As the slot in plate G is at an angle of 45 degrees with the top of the saw table, the guard will slide upward at this angle when a board is forced under the nose piece. When the guard is to be removed, it is only necessary to take out the two bolts which fasten bracket H to the feed-roll frame. This guard has proved very satisfactory, and in addition to protecting the operator from the saw, it prevents sawdust or small splinters from getting into his eyes.

Kenosha, Wis. M. E. DUGGAN

BUSHING FOR STEADYREST

The writer read with interest the description of a steadyrest bushing on page 566 of March MACHINERY. Another method of preventing the marring of ground or polished work and one which the writer believes would be more economical is to employ brass steadyrest jaws. In addition to being less expensive, jaws of this type would give a wider range of adjustment.



Babbitt-lined Bushing for Steadyrest

A compression collar bushing for use in a steadyrest when it is required to support splined shafts or shafts having keyways is shown in the illustration. The particular bushing here illustrated is designed to support shafts approximately 2 inches in diameter, and is made from a piece of scrap cast iron lined with babbitt metal. The collar is dovetailed and drilled in such a manner as to retain the babbitt under the severe usage to which equipment of this nature is usually subjected. It will be noted by referring to the illustration that there is a flat on the top of the collar. This provision is made so that the top steadyrest jaw can be tightened on this flat spot, and thus prevent the bushing from turning in the steadyrest.

If the bore of the bushing is worn, the collar can be rebored to the next larger size, or if desired, the babbitt can be melted and the collar rebabbitted. A mandrel or bushing that will give the correct bore diameter is set on a cast-iron plate to form the mold used in rebabbitting the collar. Replacements of this kind have proved satisfactory and are inexpensive.

Cincinnati, Ohio FRANK C. LANG

Do's and Don'ts on the Care of Hobs

By HARRY E. HARRIS, President, Harris Engineering Co., Bridgeport, Conn.

HOBS are expensive tools when the initial cost alone is considered. They must be carefully designed with regard to what they are to produce, and must be accurately made by skilled mechanics with costly equipment. It is therefore impossible to produce a good hob without a considerable expenditure. In spite of this high initial cost, if properly used and cared for, hobs are, in point of quality and quantity of work produced, among the most economical tools used in the manufacture of gears and other parts that permit of hobbing. This economy is due to the fact that the hobbing operation is continuous, there being no necessity of interruption for table return or indexing. The purpose of this article is to give a number of points on the care and upkeep of hobs, so that their primary high-cost may be distributed over the maximum amount of work. The rules are simple and brief, and should be followed by those responsible in any way for hobs and hobbing operations.

Hobs should be checked for tooth clearance, as the clearance often varies on teeth of the same hob due to faults of the master forming cam on the machine in which the clearance is cut or to distortion in hardening. If the amount of clearance varies, the cutting edges will assume different heights from the center of the hob when the faces are uniformly ground in resharpening. This will cause some teeth to take heavier chips than others, resulting in marks on the work.

Rules Concerning New Hobs

First, care should be taken to make sure that only good hobs are purchased, because a good hob is the only one that it really pays to use. If a hob is inaccurate or partly distorted, expensive work on individual teeth, as for example grinding the faces different amounts or otherwise, will not make the hob good, and such practice, which is merely sending good money after bad, should be discontinued. Good hobs are readily obtainable, and there is no excuse for accepting and tinkering with defective hobs.

The following rules should be carefully followed by the user of hobs:

1. New hobs should be checked for concentricity while mounted on an arbor placed between centers.

2. The clamping faces should be checked for squareness; if these faces are not square with the hole, the hob will spring the arbor on which it is mounted when in the machine.

3. The hole should be round and to size; if it is otherwise, the hob will rotate eccentrically to some extent.

4. Hobs having the tooth form and clearance ground are preferable, even on rough work, because of the longer life of cutting edges. However, if ground hobs are not used, those that have not been smoothly formed or have been pitted or scaled in hardening should be rejected.

5. Each tooth should be tested on the face and heel for hardness by employing a file or some other recognized method, but the cutting edge or clearance should not be filed, because such practice may injure the hob.

6. The faces of the teeth should be inspected to see that they are ground smoothly and that the cutting edges are really sharp and have not merely been polished bright with an elastic wheel after hardening while holding the hob by hand. The least rounding of the cutting edges causes the hob to cut hard and tear, so that it will not stand up long.

7. Hobs should be rejected when the face of the teeth is at all convex or when this surface has a negative rake, that is, when the face is tipped back from a radial line extending to the center of the hob. In fact, preference should be given to hobs having the faces slightly concave.

8. For best cutting results as regards speed of production, life of cutting edges, and smoothness of work, hobs should be so designed that the teeth can be given a rake or hook; that is, they should have the face ground under-cut from the cutting edge at from 7 to 15 degrees relative to a radial line. Such hobs cut easier, faster, and smoother, and last longer than when each tooth face is radial.

9. The gashes or flutes should not be so narrow that an insufficient chip space between the heel of one tooth and the face of the succeeding tooth will permit the hob to become clogged up with chips. Such clogging with a narrow-fluted hob is one reason that many new hobs work poorly, as compared with old hobs, which, by repeated grindings, have had the flutes widened and thus have adequate room for lubricant and chips. Hobs with fewer and wider spaced teeth and fewer flutes give far better results than hobs with more teeth which are closely spaced.

10. Each tooth should be checked for depth, form, and width by the use of templets, or a bevel gage or protractor and a depth gage.

11. The hob lead should be checked; this may be done by mounting the hob between the centers of a lathe having a good lead-screw geared for the proper hob lead and then using an indicator carried on the toolpost.

12. It is important that the gashes or flutes be properly spaced, because a hob with inaccurately spaced flutes cannot be made to cut satisfactorily. There is no excuse for inaccurate indexing of a hob when it is being made, and so it may be assumed, in instances where the flute spacing is inaccurate, either that the operator of the machine on which the hob was produced made an error in his settings or else that the hob has been distorted in hardening.

13. Hobs should be checked for tooth clearance, as this often varies on teeth of the same hob due to faults of the master forming cam on the machine in which the clearance was cut or to distortion in hardening. If the amount of clearance varies, the cutting edges will assume different heights from the center of the hob when the faces are uniformly ground in resharpening. This will cause some teeth to take heavier chips than others, and the hob will be used up faster and will make marks on the work. A hob may be checked for tooth clearance by clamping an arbor in a V-block placed on a surface plate, mounting the hob on the arbor and then rotating the face of each tooth in succession against a horizontal spring stop. As each face is brought against the stop, the amount of clearance can be measured near the tooth heel by means of an indicator in a height gage, located at a fixed distance from the end of the stop.

Caring for Hobs in Use

Care should be taken to get as much work as possible from hobs. They should not be wasted by abuse or misuse; unnecessary shut-downs of machines while waiting for hobs to be resharpened should be eliminated, and resharpening should be accurately and expeditiously done. More time and money are lost daily from neglect of the foregoing points than is generally realized. If the following rules are

observed in the use of hobs, these tools will last longer and there will be less non-productive time, higher production and lower upkeep cost.

14. A hob should never be put in a machine until it has been carefully inspected, as outlined in the preceding rules.

15. A hob should be examined each time it is used, to make sure that all cutting edges are sharp. One dull tooth is sufficient to cause hard cutting, a poor finish, and inaccurate results. Furthermore, as the dull tooth is invariably the highest one, it has the most work to do and speedily becomes excessively dull or "dubbed off," so that it may be necessary to grind the faces of all teeth 1/8 inch or more before they are satisfactory. As from 0.005 to 0.010 inch only, at the most, should be removed from the faces at a sharpening, this would result in a great loss of time and money.

16. When sharpening a hob, the grinding should never be forced. Light, quick cuts should be taken with a high-speed soft, coarse wheel. Many hobs are burnt on their cutting edges through using hard, slow running wheels or because the hob is crowded against the wheel in trying to grind it quickly. Not only may the same amount of stock be removed by light, quick cuts in the same time, but the effect of burning, even if the hob shows no discoloration, is a softening of the cutting edges, which causes them to dull rapidly and "dub off." Then at each successive grinding, a greater amount of tooth face must be ground off, and as the operator forces the grinding a little more each time, the hob is rapidly used up or cast aside as worthless.

17. Hobs should always be ground under flooded lubrication for the same reason that light, quick cuts should be taken with a soft wheel running at a high speed. The stream of lubricant should be directed at the grinding contact.

18. In sharpening a hob it is advisable to make sure that the grinding wheel will produce a smooth face. Rough scratchy grinding means fine saw-tooth cutting edges, which crumble and lose their keenness. If the proper facilities and the right wheel are not obtainable, apply an India oilstone by hand after the grinding operation, to produce fine sharp edges.

(Careful attention to Rules 16, 17 and 18 will effectively prevent burning and result in smooth surfaces and finer, keener, and more durable cutting edges.)

19. In sharpening hobs having radial faces, care should be taken to see that the teeth are not given a negative rake, as mentioned in Rule 7. In attempting to sharpen hob faces to radial lines, it is difficult to prevent this from happening, because if the cutting face of the wheel is set radial to the center of the hob, that part of the wheel grinding at the bottom of the teeth wears away much faster than the part grinding at the tops, because it has more metal to remove. The result will be a negative rake. To overcome this effect, the wheel should be set over so as to tend to under-cut or give a rake to the tooth faces. Then, after the hob is ground, the tooth faces will be approximately radial from top to bottom and slightly concave due to the wear of the wheel. The amount that the wheel should be set over varies, depending on the wheel, hob, and the amount to be ground from the latter, but the set-over may be readily determined from observation.

20. It has been proved beyond question that hobs should be under-cut, that is, that they should have the front face of the teeth slanting from top to bottom at least 8 degrees back from a radial line. The cutting angle on this style hob is generally stamped on one end of the tool, and care should be taken to maintain this angle. The cutting face of the wheel should be carefully set in resharpening, and the hob checked after such an operation. It is often possible to grind radial-tooth hobs so that the face will have a cutting angle of a few degrees. This will improve the cutting action of the hob without affecting the developed contour of the work or the depth of cut sufficiently to be objectionable.

21. It is poor practice to grind back and forth through a flute more than once at a time; the better method is to index to the next flute and grind back and forth through that flute and so on, all around the hob. The practice of grinding back and forth through a flute many times in succession is unsatisfactory, although often followed in grinding hobs with attachments or by makeshift methods. It should be avoided for the following reasons: First, because the teeth become so hot that they are burnt; second, the wheel wears and changes its shape, with the result that the cutting faces of the hob teeth are at different angles; and, finally, the spacing of the flutes becomes irregular.

22. A hob should be ground until all the teeth are sharp, because one dull tooth will cause trouble.

Do not grind back and forth through a flute more than once at a time, but rather index to the next flute and grind back and forth through that flute and so on, all around the hob. The practice of grinding back and forth through a flute many times in succession is unsatisfactory, although often followed in grinding hobs with attachments or by makeshift methods. The reason this practice should be avoided is that, first, the teeth become so hot that they are burnt; second, the wheel wears and changes its shape, with the result that the cutting faces of the teeth are at different angles; and, third, the spacing of the flutes is irregular.

23. A hob should not be allowed to remain in a machine after it becomes dull; it should be sharpened immediately. The unsatisfactory results obtained with a dull hob have previously been mentioned under Rule 15.

24. The hobbing machine should be kept running at the maximum feed and speed for the job.

25. The life of a hob must not be judged by the number of days it lasts in production, but by the number of parts or inches of metal that have been cut. Furthermore, the need for sharpening must not be judged by the number of hours run, but by the number of parts or inches of metal cut between grindings.

26. Hobs should be changed and sharpened frequently; thus less metal is required to be ground off each time. The production rate can then be materially increased by speeding up the machine. Sharp hobs will easily give double the production obtained with dull hobs.

27. The resharpening of hobs should be made easy. The reason that much work is spoiled by the use of dull hobs is that sharpening, especially of spiral-fluted hobs, is usually a difficult operation in a shop not properly equipped for this purpose. The result is that dull hobs accumulate and are often put away and used again without sharpening. Then, when a set-up is made at last to grind the dull hobs, the work is likely to be rushed through, wrong wheels, speeds and feeds being used and the hobs ground dry. Even with the most skilled grinding machine operator, results under such conditions will be poor. A machine for grinding hobs properly should always be ready to receive a job.

28. An individual record should be kept on a suitable card of the work produced by each hob. This will make it possible to compare hobs made from different brands of steel, subjected to different heat-treatments or purchased from different concerns. The results of ground hobs may also be compared with unground hobs.

29. Hobs should be kept oiled or greased when not in use, because a rusty cutting edge will not be sharp.

30. Hobs should not be stored loose on a shelf or in a box. Their edges are easily damaged in this way and they are likely to chip and nick one another in being shuffled about. Then, too, they may roll off a shelf and drop on a metal base or cement floor. A board provided with wooden pegs fitting the holes of the hobs is an excellent means of storing these tools. An individual peg board, having the name and number of the hob for which it is intended, is also satisfactory for storing hobs in a tool-room.

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, June 14

EXPERIENCE in all quarters of the engineering industry points definitely to the fact that trade is at last gathering momentum. Even the protracted labor dispute of the last two and a half months has not been sufficient to counteract the tendency toward general improvement.

The Machine Tool Trade

The machine tool trade is moving very slowly with the general trade improvement. There is a more decided tendency to buy, and the stocks of manufacturers are being slowly reduced. The machine tool trade has perhaps suffered more by the lock-out than the majority of trades, since the proportion of skilled workmen is very high in the general run of British machine tool shops.

Very little stability exists in prices of machine tools, and quotations from several firms for substantially the same machines frequently show a wide range of prices. Selling prices are controlled, not so much by the cost of production, as by the great necessity of turning money over and reducing stocks. The influence of the second-hand market continues to be felt, although the war surplus has been substantially reduced, and the machines have passed largely into the hands of the dealers instead of being put into production.

Overseas Trade in Machine Tools

Inquiry for machine tools from other countries is excellent and of a much better tone. The export and import returns for machine tools showed a small drop from the figures reached during the previous month. In tonnage, exports fell from 1447 to 1421 and in value from £184,776, to £171,612; import tonnage was reduced from 343 to 266, the value being £30,779 instead of £37,338. The value per ton of imports showed a tendency to rise after the fall over several months; the value per ton of exports continues the tendency to fall shown during the last twelve months. The imports and exports are now approximately equal in value —about £115 to £120 per ton.

Figures show that Germany is now the most important exporter into this country. During April Germany sent 141 tons of the 266 tons of machine tools imported; the amount was divided among all classes of machine tools, although drilling machines and lathes predominated. America sent 54 tons, principally grinding machines and special machines, but practically none of the classes in which Germany led. Against this, it must be realized that whereas America's contribution had a value of £12,000, Germany's much larger contribution had a value of only £8000. These figures are significant in view of the fact that Germany's contribution to the British market is now in process of growth.

New Machine Tools

A few new designs of machine tools have appeared during the last few weeks. These include radial drilling machines by Kitchen and Wade, of Halifax. A prominent feature of these machines is an auxiliary spindle for tapping purposes. The extra spindle runs at one-third the speed of the main drill spindle and can be arranged for driving right- or left-hand taps. The same firm has also introduced a line of girder type radial drilling machines.

An interesting pipe flange facing and turning machine has been developed by Haighs (Oldham) Ltd., Oldham. It is particularly suitable for machining simultaneously the three flanges of large pipe fittings such as tees, etc. Producer plant piping and many types of valves also can be conveniently faced on this machine. It is built on the lines of a lathe with heads at each end of the bed, while another bed carries a third head the spindle of which is driven in unison with the other two, and is arranged at right angles to the main bed. The work is held stationary during machining, and is gripped in two self-centering vises that can be moved to convenient positions along the bed.

The spindles carry faceplates on which are mounted facing and boring tools. The facing tools are carried on cross-slides on the faceplates and these enable facing cuts to be taken. The feed is automatic through a "picking gear" or "star wheel" operated at each revolution of the spindle. For turning the flange diameters or for boring, the heads are fed along the bed. The machine accommodates pipes up to 9 feet in length by 20 inches in diameter; one 10-inch and two 14-inch flanges can be faced and turned in two hours.

The Automobile Industry

Automobile manufacturers maintain their strong position. Demand has exceeded all expectations, and buyers are pressing for prompt delivery. There is a large accumulation of orders which though taken early in the season, are still waiting to be filled, and it is imperative that there should be no further hindrance to production.

Owing to high taxation and similar causes, particular attention has been paid to the development of automobiles which, while giving ample power for ordinary requirements, are rated sufficiently low to come within the scope of the lower grade of taxation. Cars that fulfill these requirements are about 10 horsepower, and besides being subject to a relatively low tax they can be obtained at a reasonable price and are economical to run.

So strongly is it felt that the light automobile is assured of an exceptionally bright future that, after carefully considering the question, several prominent firms have decided upon an increased output and are arranging to expand their plants accordingly. In one factory in the Coventry district, such extensions are already in progress, and when completed will provide for a threefold increase in the output.

Iron and Steel Trades and Material Prices

In the iron and steel trades there is a quiet but steady demand. Conditions in the home trade have not materially altered, and business has been held in check by the engineering dispute. However, although there is but little buying, consumers are keeping in touch with the market in anticipation of the demand arising as soon as the dispute is settled.

Foreign demands for British materials continue to increase, and for this reason steel makers are able to maintain their recent rate of output. India, Siam, South America, and South Africa are in the market for large quantities of railway equipment, and it is thought that a good share of these orders will come to this country, provided suitable credits can be arranged. The situation in the pig iron market is still encouraging, and buyers of both hematite and foundry irons may expect an advance in prices almost immediately. American buying of British iron has not developed to the extent that was anticipated, but the over-seas demand generally is good. Germany is still a prominent buyer and some sales in Czecho-Slovakia have recently been made.

Metal prices have shown little or no fluctuation during the last two months. Finished steel in the form of round bars remains at £9 15s to £10 10s per ton, while finished iron as crown bars sells at £11 to £12 10s per ton. Pig iron varies from £3 12s 6d to £4 10s, according to grade.

The Machine Tool Industry

THERE is steady improvement in the machine tool industry. New orders now average between 20 and 25 per cent of the peak business. Six firms out of seventy-seven state that their business is more than 50 per cent of peak business, which may well be considered normal or above normal. About thirty firms out of the seventy-seven are doing a business that may be considered from one-third to one-half normal or better. Stocks have been materially reduced within the last two months, and it is only in a few instances that machine tool manufacturers now say there is no improvement in their business. Practically all the shops that were shut down during the most severe period of the depression are now running to some extent, and some of the largest report sales averaging 50 per cent of what is considered normal. Such statements as, "we have had more business in the last six weeks than we had in the previous six months," or "we have had twice as much business since the first of January as we had during all last year" are not unusual.

On account of working off the stocks on hand, the shops as yet do not run in proportion to orders received, but the assembling departments of several plants are working to a satisfactory degree—some to capacity—using parts in stock. On account of the activity of the radio business, the demand for small automatic screw machines has been exceptionally brisk. All the smaller sizes of these machines that were in the hands of the used-machinery dealers, have been absorbed, and one of the well-known makers of small automatics quotes from six weeks' to three months' delivery. The demand for special machinery of certain types is also good, gear tooth grinding machines particularly being in demand, one shop operating over-time to meet this demand.

In the electrical welding machine field conditions are practically normal, the demand coming mainly from the automobile industry. Shops devoted to electric welding on a jobbing basis are also well occupied. The electrical repair and motor rebuilding business keeps the shops doing this work running at full capacity, and the electrical tool business averages about 50 per cent of normal.

Gradual Return to a Normal Business

The difficulty in making comparisons is that we have no "normal" standard with which to compare. One machine tool manufacturer, therefore, took an average of the output of his plant for the last ten years, and states that the present business is 84 per cent of that average, it being about 50 per cent of the maximum business that was done during the war years. It is of interest to note that this machine tool builder is not depending on the automobile industry for his business, but caters to the general machine-building field. Some of the well-known dealers in machine tools, having defined as normal business an average trade that will enable them to maintain their organization intact, pay overhead expenses, and realize a reasonable profit, state that business is now 50 per cent of such a normal.

In the Pittsburg district good business in second-hand machinery is reported as compared with last year; but one of the dealers states that "those who believe that the second-hand business was very brisk last year should be told that at that time most dealers in used machinery lost money." The second-hand machinery business appeared good simply because the business in new machines was small. The trade in both second-hand and new machines is now more active. In the used machinery field, large types are especially in demand, but the present owners want too high prices, sometimes as high as the present reduced prices on new tools.

Dealers who handle both new and second-hand machines in the Pittsburg district state that it is still much easier to sell second-hand machines than new machinery, because many firms that never bought used machines in the past are now forced to do so by financial considerations; but these shops will most likely buy only new machines as soon as they can afford to do so. In the Cleveland district this return to new machines seems to have already taken place, one dealer reporting that of his sales 85 per cent represents new machinery, and only 15 per cent used tools, his total sales being three times the sales for an equal period last year.

Small Tools and Accessories

The tap and die business averages from 25 to 40 per cent of capacity. Some manufacturers report the reamer business to be above the pre-war level. One firm states that the business in self-opening dies is about 40 per cent normal. The volume of business done in twist drills is quite large, several of the important manufacturers in this branch running their plants about 75 per cent normal, but prices of twist drills are very low.

The makers of special tools, jigs, and fixtures average about 50 per cent of a normal business, and a few of these shops are running full and even over-time. On the other hand, a great many of them have gone out of business, thereby increasing the opportunities for those that remain. It is well known that many makers of special tools started in the business during the war years, and with the return of peace conditions there could not possibly be enough business for all. Those who had the best organizations and were best qualified to meet the requirements have survived.

The vise business may be said to be practically normal. Two of the important vise manufacturers state that the volume is greater than the pre-war business. One of the large shops making vises is running practically to capacity, while others report business considerably improved, but not yet up to normal.

In the ball and roller bearing field the activity is 100 per cent; in fact, in some instances it is above 100 per cent, the overflow work being taken care of in outside shops. This activity is due mainly to the heavy demands of the automobile industry.

Forging and Foundry Business

The drop-forging shops are fully occupied, and those engaged in making automobile forgings have difficulty in meeting the demands. There is considerable demand for forgings for railroad cars, large orders for which have been placed by the roads during recent months. One of the forging shops, specializing in steam and gas engine forgings, operates at 75 per cent capacity, and one plant making general machine forgings, at from 40 to 50 per cent capacity. Prices for forgings, which were very low a year ago, have come up to a point where it is now possible to operate without a loss. The activity in the forging shops has placed a fair demand upon steam hammers, and one of the plants building this kind of machinery operates at two-thirds capacity. Business is at present fair in the forging machinery line, and one of the plants specializing in this line is putting on men, expecting a fair business in the fall, while another plant is running full time and full force in most of its departments.

The foundry business is much better, and prices of castings have increased to a level that is said to be satisfactory by the foundry operators. The die-casting business is operating at about 75 per cent capacity. The upward trend is distinct and definite.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Heald Cylinder Grinding Machine

AMONG the important factors upon which successful automobile cylinder grinding depends are the smoothness of the table movements and the rate of table feed. To insure efficiency of table operation on the machine here illustrated, a hydraulic arrangement operated by oil is utilized to drive the main table. By means of this arrangent any table feed from zero to maximum is instantly obtainable, and reversing of the table may be effected at any desired point without shock or noise. This machine is a recent addition to the line of grinding equipment built by the Heald Machine Co., 16 New Bond St., Worcester, Mass., and is known as the No. 50. It is intended for both manufacturing and repair shops. The hydraulic arrangement incorporated in its design is also applied on an automatic piston-ring grinding machine built by this firm and described in February MACHINERY.

The main driving shaft is placed on the rear of the bed as shown in Fig. 2. It is mounted in ball bearings and is designed to be driven directly from a lineshaft at a constant speed, thus eliminating the necessity of a countershaft. The grinding head and the feeding arrangement for the eccentric are similar in design to those that have been used successfully by the builders of this machine for over seventeen years. For the benefit of those not familiar with the construction, it may be stated that the locating head is made up of two eccentrics, one within the other, which give the grinding spindle a sort of planetary adjustment for accurately feeding the wheel to the work. There are three speeds for the eccentric which are controlled by a convenient lever.

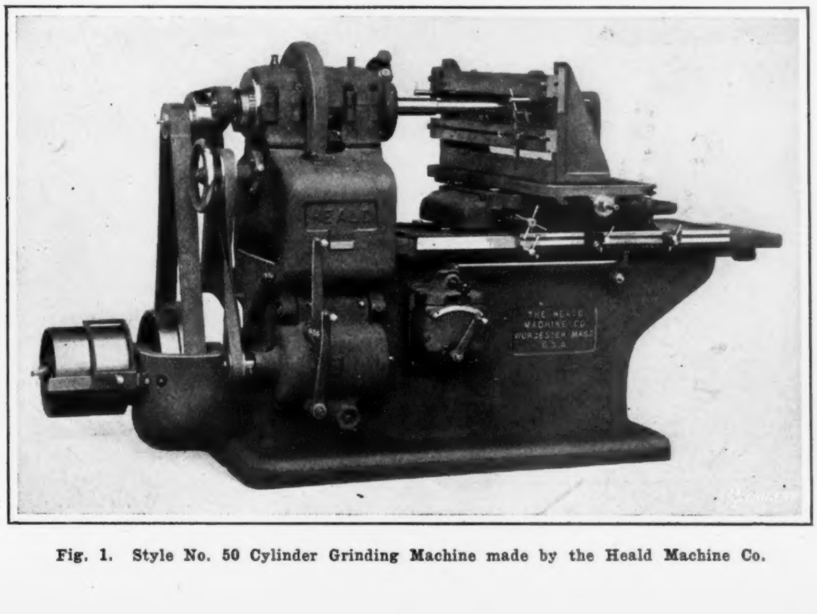


Fig. 1. Style No. 50 Cylinder Grinding Machine made by the Heald Machine Co.

The grinding spindle is driven from the driving shaft through an idler which maintains a uniform belt tension. The spindle is hardened, ground, and runs in a taper bronze bearing at the wheel end and in a self-aligning ball bearing at the pulley end. It is equipped with interchangeable pulleys which provide different speeds for the grinding wheels, so that the operator can always obtain the correct speed for the work in hand, whether using large or small wheels. The depth of cut is obtained by a feeding mechanism on the right-hand end of the rotating head. This is operated either by means of a knob when a small adjustment is desired, or

through a small crank when large adjustments are to be made, as when changing the setting of the wheel to suit the grinding of different sizes of holes.

An 11–18-inch combination spindle for grinding holes 2⅜ inches in diameter and larger by 11 inches long and holes 3 inches in diameter and larger by 18 inches long, is regularly supplied, although the following sized spindles may also be furnished: 7½-inch, which grinds holes 1⅛ inches in diameter and larger by 7½ inches long; 10-inch, which grinds holes 2⅜ inches in diameter and larger by 10 inches long; 18-inch, which grinds holes 3 inches in diameter and larger by 18 inches long; 23-inch, which grinds holes 5 inches in diameter and larger by 23 inches long, and holes 3 inches in diameter by 16½ inches long; and special 15- and 18-inch spindles that are intended for use with large wheels.

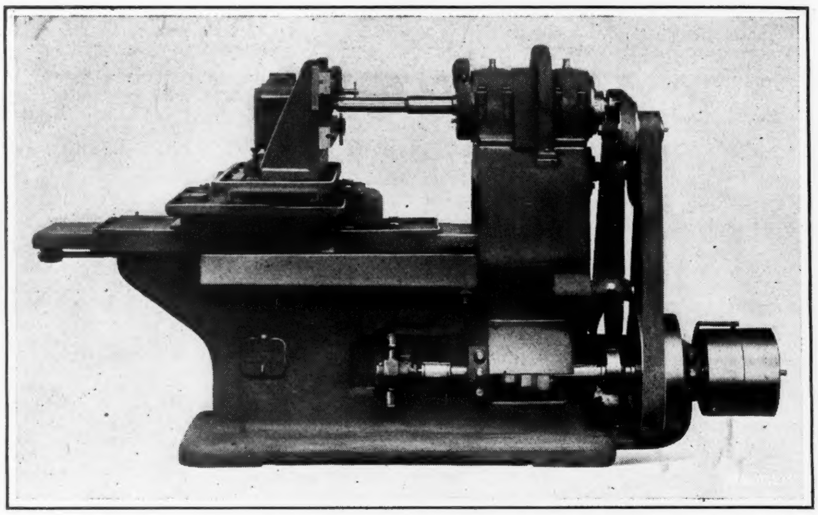


Fig. 2. Rear View of Cylinder Grinding Machine showing the Driving Arrangement

Main and Cross-slide Tables

The main table is heavy, wide, and of sufficient length to protect fully the ways on which it slides from grit or dirt. These ways are of dovetail form, and the table is gibbed to them. Oil-pockets and rolls provide adequate lubrication. The cross-slide table has an adjustment of 28 inches through a feed-screw equipped with a dial graduated to thousandths of an inch. Adjustable dogs are used to indicate long distances through which the table is moved, such as when traveling from hole to hole. Exact distances are obtained by means of the micrometer dial on the feed-screw; this can be set at zero for the first hole, and the position of the dial noted for the other holes.

A vertical adjustment of the cross-slide table up to 5/16 inch is obtainable through two inclined slides between the cross-slide table and the main table. This adjustment is made by turning a small pilot wheel connected through gears to a screw which causes the upper of the inclined slides to be moved on the lower inclined slide. In so doing the upper inclined slide causes the cross-slide table and work to be raised or lowered, depending upon the direction in which the pilot wheel is rotated.

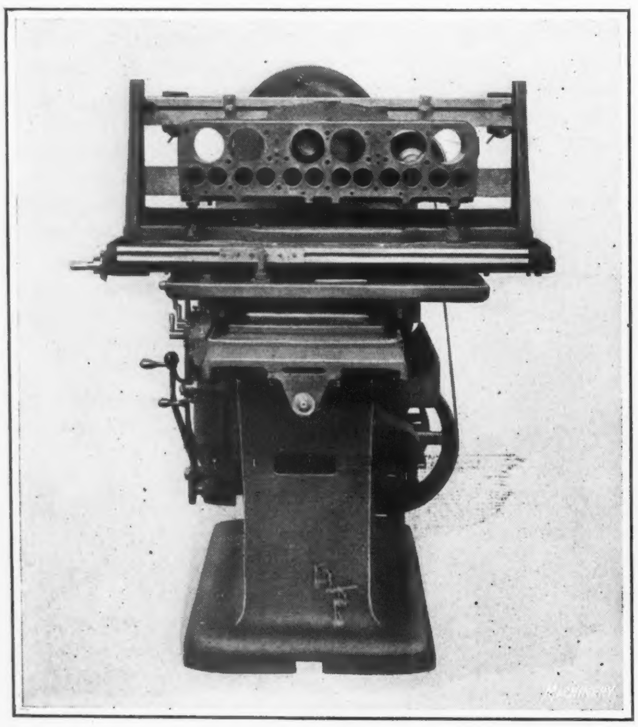


Fig. 3. End View of Heald Grinding Machine showing the Manner of setting up a Cylinder Block

As only a slight vertical adjustment is required to obtain the exact position or to take care of any vertical errors that may exist in the different bores of a cylinder casting, the 5/16-inch vertical movement of the cross-slide table is employed. To accommodate the handling of a large variety of work, a universal jig can be furnished, which locates the hole for the grinding center. When the work is of such a size that there is not a sufficient distance between the grinding center of the eccentric and the top of the cross-slide table, all slides and the cross-slide table can be removed so the operator can set up the work directly on the main table.

Universal Quick-locating Jig

A universal quick-locating jig having a capacity for all styles and sizes of cylinder blocks used with standard makes of automobiles may be furnished for the use of regrinding shops and manufacturers desiring such equipment. This jig is constructed of two bars bolted to the face of an angle casting. The bars can be so adjusted that the center of the holes to be ground will be at the correct height for the grinding wheel to enter the hole.

The standard grinding wheels for the regular 11–18-inch grinding spindle are 2¾ and 3½ inches in diameter. The speed of these grinding wheels is 4950 and 4500 surface feet per minute. A 5-horsepower motor having a speed of from 1000 to 1200 revolutions per minute is recommended for a motor-driven machine. The weight of this machine, when fully equipped with the universal jig, is about 5000 pounds.

ACKERMITE BEARING METAL

A bearing alloy consisting of copper and lead is being produced by the Ackermite Co. of America, 3643 Beaubien St., Detroit, Mich., by a patented process which is claimed to insure a uniform alloy that has no tendency toward segregation of its two components. The metal is cast solid or cored in bars 12 inches long and from ½ to 8 inches in outside diameter. These bars may be used in various ways for lining bearings; they may be remelted to allow the metal to be poured into the bearings, or they may be cut up and machined to form bearing bushings. Ackermite may be cut freely.

When used as a lining for bearings, Ackermite will wear away in time, but a shaft will not become scored while running in a bearing lined with this material. Under high temperatures resulting from lack of lubrication or especially severe service, small quantities of lead will be given off from the alloy. These particles of lead act as a lubricant which prevents bearing trouble. Ackermite may be used for lining any bearings in which babbitt is customarily employed. A somewhat similar alloy is produced by the same company for making steam-engine packing rings.

PAWLING & HARNISCHFEGER BORING, DRILLING, AND MILLING MACHINE

A high-precision horizontal boring, drilling, and milling machine which is equally adaptable to tool-room and manufacturing work has been recently developed by the Pawling & Harnischfeger Co., 3826 National Ave., Milwaukee, Wis. In a test, a surface 22 inches square is said to have been milled flat within 0.001 inch. This degree of accuracy is claimed to be possible because of the use of square-lock, narrow guides with taper gibs, and an unusually heavy construction of the spindle, saddle, and column, coupled with scraped sliding fits. All sliding members on the machine have a take-up for wear. Attention is called particularly to the centralized control, the automatic stops for the saddle and platen, and the interchangeable externally and internally driven faceplates.

From the close-up view, Fig. 2, it will be seen that all operating levers and handwheels are within easy reach of the operator and conveniently arranged for controlling the different operations. The starting, stopping, reversing and changing of feeds or speeds by hand or power are controlled by the operator without moving from his position. All levers are interlocking so that it is impossible to have two conflicting speeds or feeds in action at the same time.

The column is of heavy box construction, and grooved and tongued to the bed. The latter is also of box section and contains chutes for the quick removal of chips. The bed is cast in one piece with four walls under the column. The feeding, feed-distributing, and rapid-traverse mechanisms are contained in the bed. The platen contains T-slots and can be arranged for using cutting compound in connection with an operation. All bearings in the saddle are phosphor-bronze bushed, and the main spindle sleeve bushing is also made from phospher-bronze and scraped to a light taper to furnish a means of readily taking up wear of the spindle driving sleeve. The guide on the column for the saddle is located at the front close to where the cutting pressure is applied. Adjustment for wear of the saddle is made by means of two steel tapered gibs. The saddle can be raised and lowered on the column either through a handwheel, power feed or quick traverse. A counterweight for balancing the saddle members is located within the column. The spindle is a high-carbon hammered alloy steel forging, and it is ground to a sliding fit in its driving sleeve. Power for driving the spindle is applied at its front end, and power for feeding it is applied at the rear end through a rack and pinion. This construction permits the use of large bearings at the front and rear. The front end of the spindle is bored to a Morse taper and contains slots for driving milling cutters and boring-bars. The drive is delivered to the spindle either through a small faceplate by means of a wide-faced coarse-pitch gear or through a large faceplate by means of an internal gear. This large faceplate has tapped holes to provide for attaching milling cutters and facing heads. The spindle driving sleeve contains adjustable bronze taper shoes for taking up wear due to the spindle sliding in the sleeve.

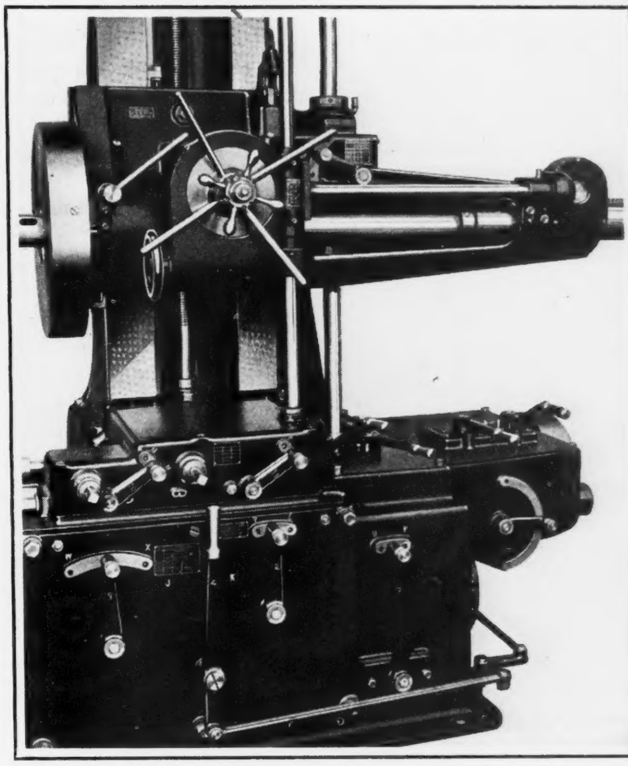


Fig. 2. Close-up View showing Centralized Control on the Pawling & Harnischfeger Boring, Drilling, and Milling Machine

Sixteen speeds ranging from 14.5 to 225 revolutions per minute are obtainable with a pulley speed of 350 revolutions per minute, when the small faceplate is used. When the larger faceplate is used, the speeds obtainable with the same pulley speed, range from 8.7 to 136 revolutions per minute. Power is transmitted to the machine by a belt directly connected to a lineshaft. For a motor-driven machine a five-horsepower constant-speed motor running at a speed of from 1200 to 1400 R.P.M. is recommended.

The feeds obtainable are eight in number and range from 0.005 to 0.288 inch per revolution of the spindle for boring, and from 0.0084 to 0.44 inch per revolution of the spindle for milling, when using the small faceplate. When using the larger faceplate, feeds ranging from 0.0008 to 0.48 inch per revolution of the spindle for boring,

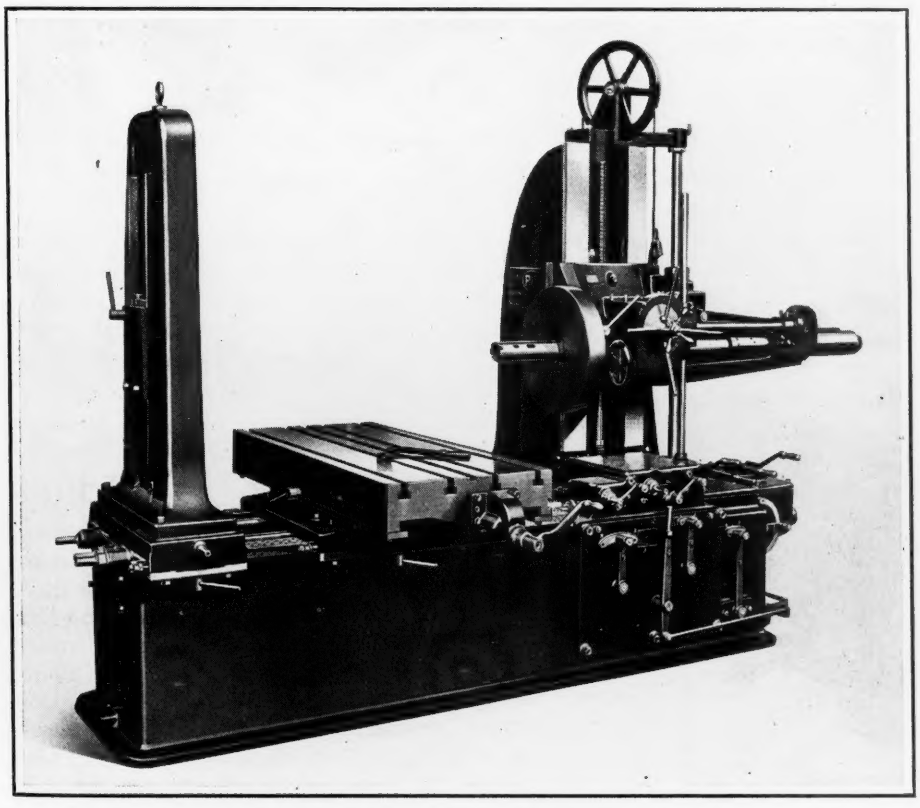


Fig. 1. No. 3T Horizontal Boring, Drilling, and Milling Machine brought out by the Pawling & Harnischfeger Co.

and from 0.013 to 0.73 inch per revolution of the spindle for milling, are obtainable.

The boring-bar support can be removed from its base without disturbing any of its mechanism. Helical gearing is used between its screw and the saddle screw so as to have a minimum amount of backlash. A thread-chasing attachment can be furnished to cut threads from 2 to 16 per inch. Other attachments which may be supplied include a circular swiveling table 24 inches in diameter, graduated to minutes and having a hand or power feed; an auxiliary table 5 feet long by 5 inches wide for supporting long work; boring-bars of any diameter up to 3 inches; and a star-feed facing head for facing work up to 16 inches in diameter. The facing head can be clamped to the spindle or bolted to the faceplate. Some of the specifications of this machine are as follows: Travel of spindle, 23½ inches; maximum distance between faceplate and boring-bar support, 5 feet; maximum distance from top of platen to center of spindle, 28 inches; top surface of platen, 24 by 54 inches; cross-feed of platen with automatic trip, 36 inches; and weight, 11,300 pounds.

NEWTON CRANK PLANER

Locomotive cross-heads, shoes and wedges, die-blocks forming dies, and other parts which it is desirable to machine on a planer having a short stroke, are included in the class of work for which the heavy-duty crank shaper illustrated was designed. This machine has been brought out by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. The rated capacity is for work 32 inches wide by 32 inches high, and the maximum stroke is 34 inches. The base is a one-piece box casting to which the uprights, which are also of box cross-section, are bolted and doweled. The driving motor is mounted on the left-hand side of the machine, as shown in Fig. 1.

Variations in table speed are obtained through a gear-box on the right-hand side of the machine, which may be seen in Fig. 2. By means of this gear-box, 6, 8¼, 12 1/3, 17½, 23 2/3, and 35½ strokes per minute are obtainable. The gears in this box are all of the sliding type, made from hardened steel, and are fully enclosed to run in oil. The main driving gear is of the helical type, has a face width of 4½ inches, and a diameter of 37 inches. It drives the rocker arm, and gives a relatively uniform speed to the table, although the speed is slightly lower at the beginning of a cut. The compactness of the drive will be apparent by reference to Fig. 2.

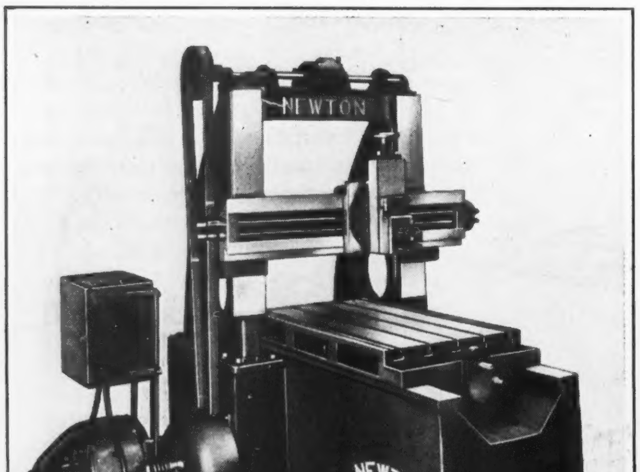


Fig. 1. Heavy-duty Crank Planer built by the Newton Machine Tool Works, Inc.

The table is of the double-plate construction, and has an adjustment of 20 inches, which can be made while the machine is in operation. After the table has been positioned, the driving element is solidly clamped by means of the square-end shaft at the front end of the table. The length of stroke is set from the operating side of the machine, an indicator showing the stroke for which the machine is arranged at any given time.

The table operation is controlled by means of a clutch and brake operated by a lever on the right-hand side of the machine (not shown in the illustration). Provision is made for locking this lever when it has been moved to the disengaged position to prevent it from re-engaging and possibly injuring the operator. The feeding mechanism is of the cycle type, being operated during the return stroke of the machine. Power is transmitted to the cross-rail through a rack and pinion to furnish the transverse, downward, and angular feeding movements. The cross-rail is raised and lowered by screws driven from the shaft extending along the top brace. In an operation, this machine has taken cuts ⅜ inch deep on steel forgings, with a feed of from 1/16 to ⅛ inch per stroke.

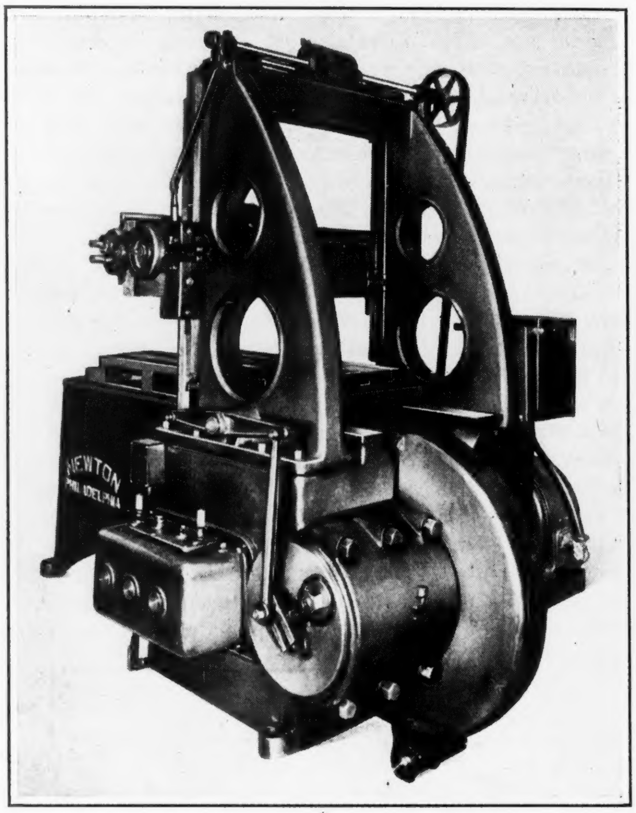


Fig. 2. View of Newton Crank Planer showing the Compact Design of the Units on the Operating Side

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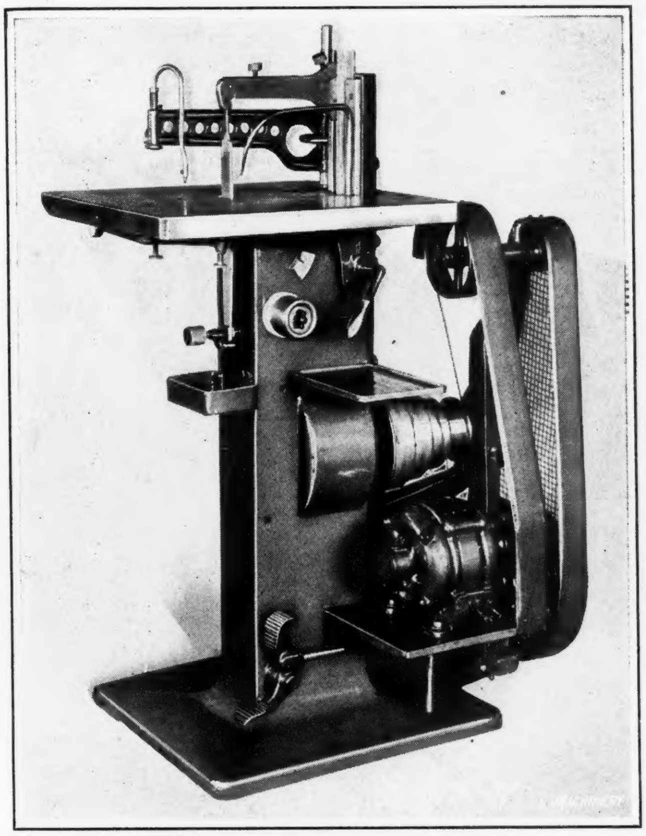
OLIVER HIGH-POWER FILING MACHINE

To permit the rapid filing of work up to 9 inches in height (although work up to 6 inches in height is recommended when the machine receives constant use), the Oliver Machinery Co., Grand Rapids, Mich., is building the filing machine here illustrated. This machine takes all sizes of standard or special files from a 3-inch long needle to a 14-inch bastard. The file is operated at four different speeds, ranging from 80 to 320 strokes per minute. The length of stroke is adjustable from ½ to 7 inches, the adjustment being effected by means of an eccentric inside the column, which is readily accessible. This eccentric is connected with the vertical slide mechanism by a telescopic connecting-rod,

which permits the use of the different lengths of files. The four-step cone pulley used for driving the machine is directly connected to the eccentric shaft. All moving parts are balanced by a counterweight to insure smooth operation.

The working surface of the table measures 20 by 24 inches. The table tilts to provide for the filing of draft or clearance in parts. A clamping arm, which swings over the table and holds the work, is designed to so regulate the pressure on the work that it may be easily forced against the file. This clamping arm eliminates any danger of the work being forced upward with the file, and the possibility of injuring the fingers of the operator. The file is released 1/32 inch from the work on the up stroke by means of a patented arrangement in the head. This movement is produced by a cam on the inside of the cone pulley. It serves to lengthen the life of files and results in a uniform degree of clearance on dies and other particular work. A self-contained pump and diagonal grooves on the table carry filings from the point of contact of the files with the work.

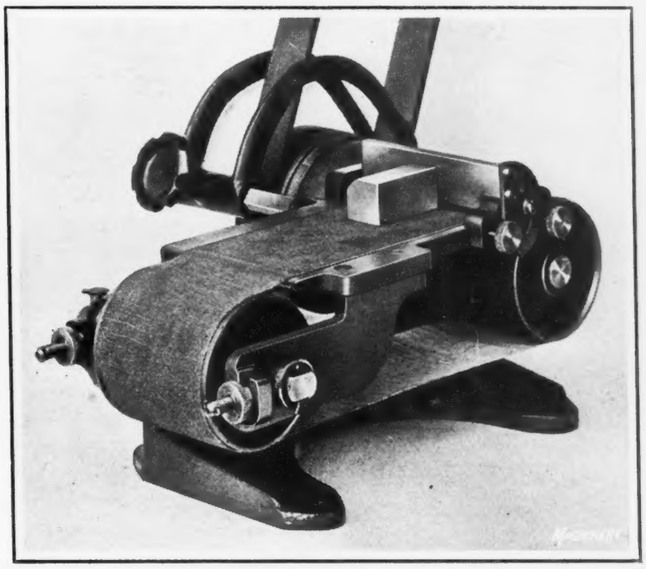


Filing Machine of a Recent Design placed on the Market by the Oliver Machinery Co.

The vertical slide has a cast-steel arm welded to its lower end on which provision is made for aligning both straight or taper files with the work. Extra attachments which may be furnished, include an overhead supporting arm for use in filing closed bottom dies or similar work, a lower supporting clamp for filing closed top dies or work of that kind, and a sawing attachment which consists of upper and lower arms for holding hacksaws. A ½-horsepower motor, operating at a speed of 1800 revolutions per minute, is mounted on the machine as shown. It is belted to a speed-reducing jack-shaft which has a yoke support that makes the machine a self-contained unit. The weight of this filing machine is about 700 pounds.

COATS ABRASIVE-BAND GRINDER

An abrasive-band grinder for straight-line finishing of all kinds of small metal parts, and for polishing fiber, vulcanized rubber, wood, and similar materials, is now being introduced to the trade by the Coats Machine Tool Co., Inc., 112 W. 40th St., New York City. Satisfactory results can be obtained in operating this grinder with unskilled help. A uniform band speed and a comparatively large grinding surface are two other advantages claimed. The work is applied to the band as the latter travels over the table. The tension on the band may be regulated to insure smooth operation, by adjusting the front band pulley, either forward or backward. This is done by turning two nuts. A graduated rest or back stop, which is detachable, may be adjusted 45 degrees either way to facilitate the grinding of angular surfaces.



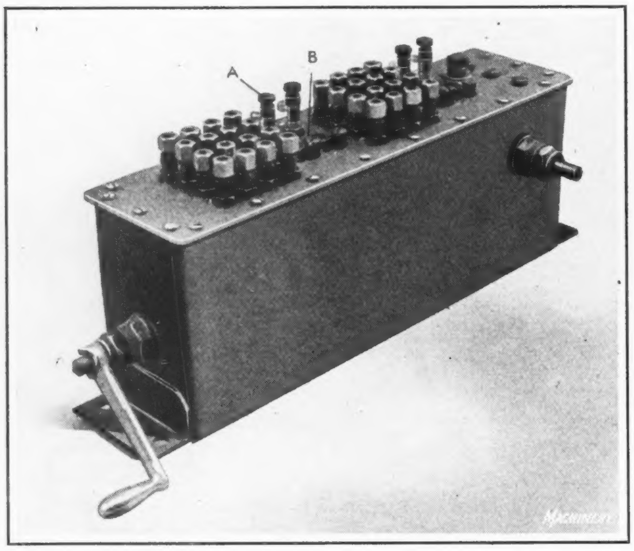
Abrasive-band Grinder recently placed on the Market by the Coats Machine Tool Co., Inc.

The loose pulley runs on a cast-iron sleeve extending from the body casting, instead of being mounted on the driving shaft, and so eliminates belt strain on the driving shaft when the machine is idle. All bearings are dustproof and are supplied with lubricators. The driving shaft runs in an oil-retaining bushing. Bands of various materials may be supplied for use on this grinder. The surface of the table measures 10 by 5½ inches, and the abrasive band is 4 inches wide by 36 inches long. The approximate weight of this grinder is 60 pounds.

MADISON-KIPP MACHINE TOOL LUBRICATOR

Adequate lubrication of the bearing surfaces on machine tools is usually a troublesome problem for designers, and so the automatic force-feed lubricator here illustrated will be of special interest to them, as well as to maintenance engineers. This lubricator is built in various styles by the Madison-Kipp Corporation, Madison, Wis., for application to practically every machine tool, from large complicated automatics to simple bench grinding machines. The device may be arranged to deliver lubricant to any number of bearing surfaces from four to one hundred without becoming bulky, the particular lubricator shown in the illustration being provided with thirty-two feeding outlets. These outlets are connected by means of tubes to the surfaces to be lubricated. The lubricator is built in a standard design, consisting of a reservoir and a cover to which are fastened pumping units for delivering lubricant to the sets of feeding outlets.

The lubricator operates on the Kipp valveless pumping principle, the main feature of which is a grooved plunger actuated by a double eccentric which causes a registration of inlet and outlet ports with the grooves of the plunger. For each stroke of the plunger, there is only one path through which oil may escape to one of the bearings fed by a pumping unit. Either four or eight outlets can be fed by each unit. The lubricator is driven by the machine it lubricates, and therefore starts and stops with it. It may be arranged with the driving shaft extending from one side of the reservoir, from one end, or from the top. The



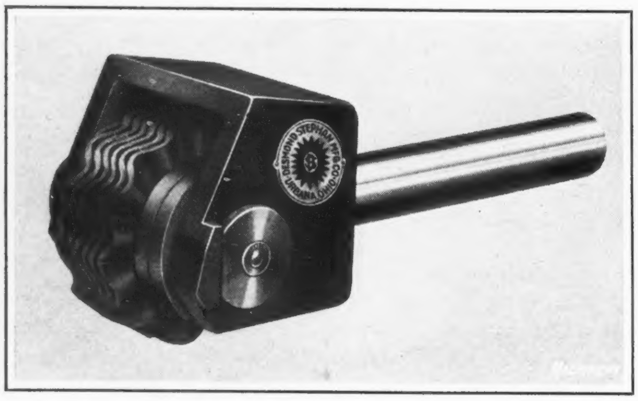
Lubricator for Machine Tools, which is manufactured by the Madison-Kipp Corporation

drive may be of a ratchet type requiring a reciprocating motion or through a pulley to which power may be transmitted from a shaft on the machine.

The amount of oil delivered to an outlet can be regulated from as little as one drop per eight revolutions of the pump driving shaft up to ten drops per eight revolutions of this shaft. This regulation is accomplished by means of a button *B* located on the cover for each set of four or eight outlets. The speed of the driving shaft may also be changed to obtain a further regulation of the amount of oil delivered. Means for observing the amount of oil being delivered by a pumping unit is provided by a test connector *A*. The reservoir is provided with an oil level indicator, filler cap, and strainer. The design of the lubricator is such that the reservoir can be made an integral part of a standard machine casting, and the cover supplied with the pumping mechanisms attached. The reservoir is sometimes built with two compartments to permit the use of two grades of oil. The crank on the lubricator furnishes a means of delivering oil when starting a machine after it has been idle for a long time.

DESMOND-STEPHAN GRINDING-WHEEL DRESSER

A grinding-wheel dresser in which tool-steel cutters are mounted on a bushing which revolves on a roller bearing and thus minimizes wear of the bearing surfaces, is a recent product of the Desmond-Stephan Mfg. Co., Urbana, Ohio. This dresser is designed for use either while mounted in a toolpost or on a magnetic chuck. When used with a magnetic chuck, the flat surface of the holder shown uppermost in the illustration rests on the chuck. The cutters are 2 3/8 inches in diameter, and are of a corrugated form. The rollers of the bearings on which the cutter bushing rotates revolve, in turn, on a 3/4-inch diameter pin. The bearings are dustproof, and have a simple means for oiling. It is said that in a fifteen hour test with one of these dressers, the bearings showed no indication of wear, although the cutters were reduced 3/16 inch in diameter.



Desmond-Stephan Roller-bearing Grinding-wheel Dresser

NEWTON CONTINUOUS MILLING MACHINE

Users of quantity production equipment will be interested in the new 30-inch continuous milling machine shown in the accompanying illustration. This machine has been added to the line of machine tools manufactured by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. The machine is shown equipped for using cutting compound, but the large pan is omitted when handling iron castings. The table of the machine has two separate and distinct types of feed, the first of which is continuous and is used for straight continuous milling. The second feed is intermittently a feed and a rapid traverse and

Thirty-inch Continuous Milling Machine brought out by the Newton Machine Tool Works, Inc.

is intended for use with limited quantities of parts or when there is considerable space between the surfaces to be machined. The rapid traverse is 10 2/3 times the rate of feed. The feeds are variable through change-gears. The table has a solid top to which jigs may be bolted and doweled. There are two bearings, one of which is of an annular type. The table overhangs the saddle only 5/8 inch, so that there is no twisting or buckling. It is rotated by a fully enclosed helical gear running in oil. The pinion that drives the table and the helical gear is rotated through worm-gearing.

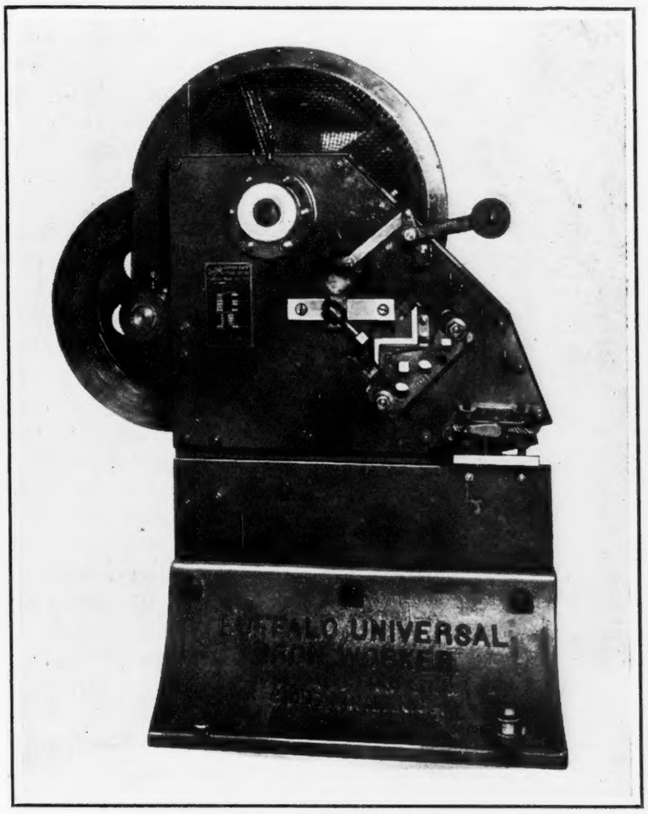
A safety clutch prevents breakage of tools or machine members in the event of overloading or jamming the machine. The table saddle is adjustable on the base to permit the table to be positioned properly relative to the cutters. The two spindles have a No. 5 Morse taper hole, face keyway and draw-in bolt. They are driven by hardened

steel gears and supported between bearings fully enclosed and running in oil. The sleeve in which each spindle is contained has an individual end adjustment of 2 inches for setting cutters and may be clamped after such a setting has been made. The motor drives through change-gears, which provide a variation in spindle speeds.

Some of the principal dimensions of this machine are as follows: Distance from center of spindles to upright, 10 inches; distance between spindle centers, 13 inches; minimum and maximum height from top of table to lower end of spindle, 4 and 12 inches, respectively; diameter of table working surface, 30 inches; and maximum distance from center of spindle to center of table, 18 inches. The machine is driven by a 7½-horsepower motor running at 1200 R.P.M.

BUFFALO UNIVERSAL SLITTING SHEAR AND BAR CUTTER

A universal slitting shear and bar cutter, designed particularly for use in shops where punching equipment is not required, has just been placed on the market by the Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. The shearing unit



New Universal Slitting Shear and Bar Cutter built by the Buffalo Forge Co.

is equipped with 10-inch knives which will cut plates ½ inch thick of any length or width, or 6- by ⅝-inch flat bars. These knives may be operated at thirty strokes per minute.

The bar-cutter unit is regularly supplied with 5-inch knives, which will cut 4- by 4- by ⅜-inch angle-iron square; 3- by 3- by ¼-inch angle-iron to a 45-degree miter, either right- or left-hand; 3- by 3- by ⅜-inch T-iron square; round bars up to 1⅝ inches in diameter, and square bars up to 1½ inches. When furnished with special knives, I-beams up to 5 inches, 9.76 pounds, and channel iron up to 5 inches, 9 pounds, may be cut, as well as other rolled sections having the same cross-sectional area. One set of blades suffices to shear both channel irons and I-beams of the same nominal size, but a different pair of knives is required for each size. This machine has an armor plate frame. About 3 horsepower is required to run this machine at full capacity. Its over-all length is 5 feet 4 inches; width, 2 feet 8 inches; height 6 feet 4 inches; and weight, 4500 pounds.

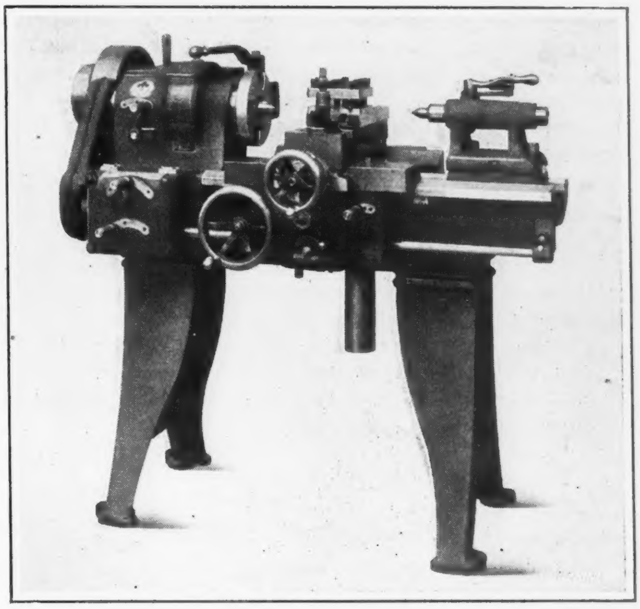


Fig. 1. Eleven-inch Rapid-production Lathe placed on the Market by the R. K. LeBlond Machine Tool Co.

LEBLOND HEAVY-DUTY RAPID-PRODUCTION LATHE

Heavier cuts, greater production, and quicker manipulation than are possible with ordinary lathes of the same size were the aims of the engineers of the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, in designing the 11-inch rapid-production lathe illustrated in Figs. 1 and 2. This machine is especially intended for small-diameter turning and facing jobs in automobile and other manufacturing plants. The headstock is of the selective speed type, and provides six speed changes through sliding gears driven from a constant-speed pulley. This pulley is driven by a multiple-disk automobile-type clutch which runs continuously in oil. The pulley revolves on a bushing, and thus relieves the driving shaft from belt pull. The six speed changes are secured through the operation of two levers.

All gears in the headstock are made of nickel steel, hardened, and have stub teeth which are rounded to facilitate their engagement. The sliding gears are mounted on short shafts having four keyways. The keys in the gears are broached from the solid. The headstock spindle runs in taper bronze bearings which are babbitt-lined and adjustable for wear, and is also provided with ball thrust

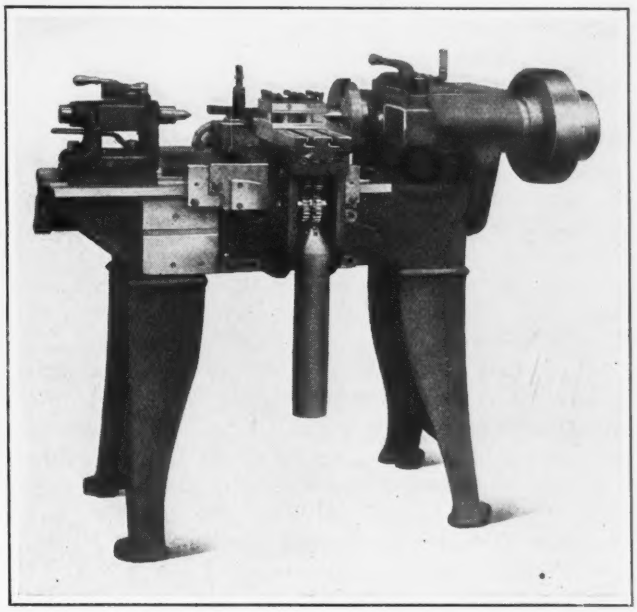


Fig. 2. Construction of Facing Attachment mounted on Rear of LeBlond Rapid-production Lathe

bearings. The spindle has a large hole extending through its entire length to permit the passing of work through it or the mounting of draw-in or expansion chucks, which may be operated either by hand or automatically. When the clutch is released from the driving pulley, a brake is automatically applied to the spindle.

The feeding mechanism is especially designed to meet the requirements of large-quantity plain turning and facing work. It consists essentially of a feed-box which provides nine feed changes for the carriage by the manipulation of two levers. The bottom lever compounds the range of feeds obtainable by means of the top lever, and this gives a quick change of feed without the necessity of gradually stepping the feed upward through a series of gear combinations until the desired feed is obtained. The feed is transmitted to the carriage by operating a lever on the apron which controls a positive clutch. The gears in the feed-box are driven directly from the spindle by means of sprockets. The sprocket chain is adjustable to vary its tension. The bearing surfaces of the carriage are scraped their entire length, and all bearings in the apron for gears and shafts are cast integral with the apron casting.

The tailstock is of an improved design, arranged to permit the quick removal and replacement of work with a single movement of the operating handle. The tailstock center may be brought into contact with the work at any desired pressure by means of a second lever, a further movement of which serves to lock the tailstock barrel rigidly and clamp the spindle. A facing attachment is furnished for work requiring facing or grooving; this attachment allows such operations to be accomplished at the same time as turning operations. The application of this facing attachment really converts the machine into a semi-automatic lathe for covering a range of smaller and lighter work than that for which the "multi-cut" lathes built by the same company are intended.

From Fig. 2 it will be seen that the facing attachment is mounted on a bracket bolted to a planed pad on the rear of the bed. The bracket is adjustable to any desired position along the bed. A roller on the attachment engages a simple cast-iron form plate bolted to and traversing with the carriage. This roller transmits the motion imparted to it by the form plate, through a rack and pinion to the facing slide, and thus feeds the latter toward the center of the lathe. The facing slide is dovetailed and gibbed to the attachment bracket. When the carriage is brought back along the bed toward its starting position, the facing attachment is also automatically returned by the counterweight. The form plate for controlling the movements of the facing attachment is readily interchangeable with one of greater or less taper to vary the movement of the slide.

Among the special equipment that may be supplied for this machine are included a draw-in attachment and collets, a turret toolpost for the carriage, an oil-pump, pan and piping, an automatic stop for the carriage, and multiple cross-stops. The principal specifications are as follows: Maximum diameter of work which can be turned, 13¾ inches; maximum length of work which can be handled, 18½ inches; range of spindle speeds, 50 to 250 revolutions per minute; range of carriage feeds, 0.008 to 0.092 inch per revolution of the spindle.

NUT CASTELLATING AND "HEXING" MACHINE

For castellating nuts and milling hexagonal ends of spark plugs, the semi-automatic machine illustrated has recently been designed by the Manufacturers' Consulting Engineers, McCarthy Bldg., Syracuse, N. Y. While the machine is primarily intended for the automobile trade, it is applicable to other operations similar to those mentioned. The machine is essentially a high-production tool. With each indexing movement of the work-holding turret, a nut, spark plug, or some other part is completed. The collets in the turret for holding the work are opened and closed automatically at the loading station, and so the only manual labor required is loading.

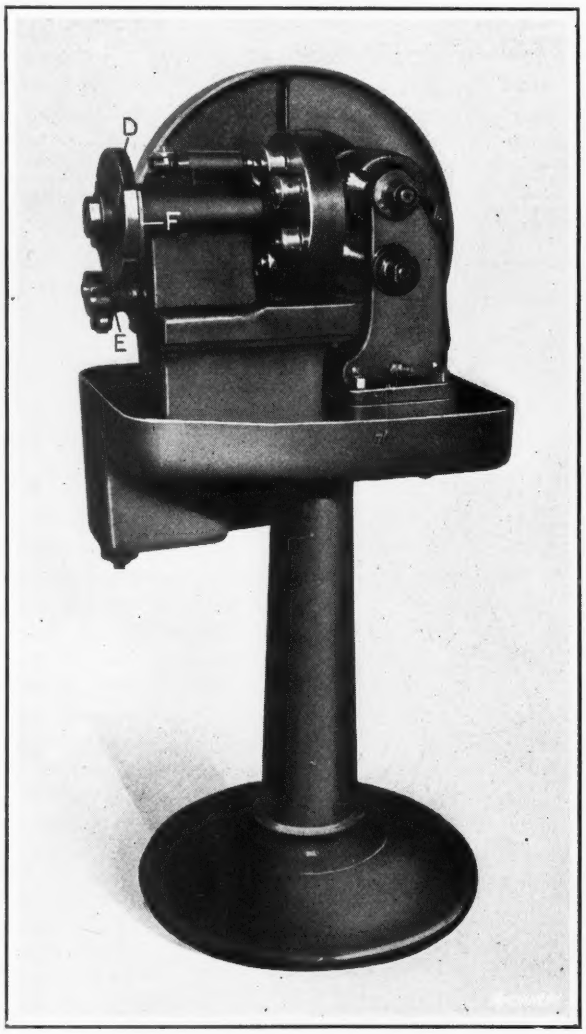


Fig. 1. Nut Castellating and "Hexing" Machine brought out by the Manufacturers' Consulting Engineers

The machine is driven through a large pulley which also serves as a flywheel. This pulley is equipped with a clutch that is operated by means of a convenient handle. From Fig. 1 it will be seen that the turret is mounted on a sliding head and has six work-holding stations. This head slides forward and backward to bring the work into and out of contact with cutters mounted on two arbors placed at right angles to the axis of the turret. The turret is indexed one position, or 60 degrees, prior to each forward movement of the head.

In Fig. 2 the two cutter-arbors *A* and *B* are provided with one and two cutters, respectively, for castellating nuts. Arbor *A* is driven directly from the main driving shaft and arbor *B* from this shaft through spur gearing. Shaft *C*, which is driven from the driving shaft through worm-gearing, extends through the machine to the indexing end. On this shaft are mounted an indexing cam and a special side cam. The front face of the side cam operates a mechanism for automatically chucking and releasing the work, and the other face imparts the feeding and returning movements to the turret head. An adjustable stop in the collets provides for placing the work properly to obtain the correct depth of cut.

In loading, the adjustable stop is pressed against an ejector that also serves as a stop, at which time the collet is automatically closed on the work. A pawl on the rear side of the index-plate *D*, Fig. 1, remains in engagement with one of the six notches in the index-plate, until the loading has been completed, when a pin on the indexing cam releases this pawl. A lobe on the cam then pivots lever

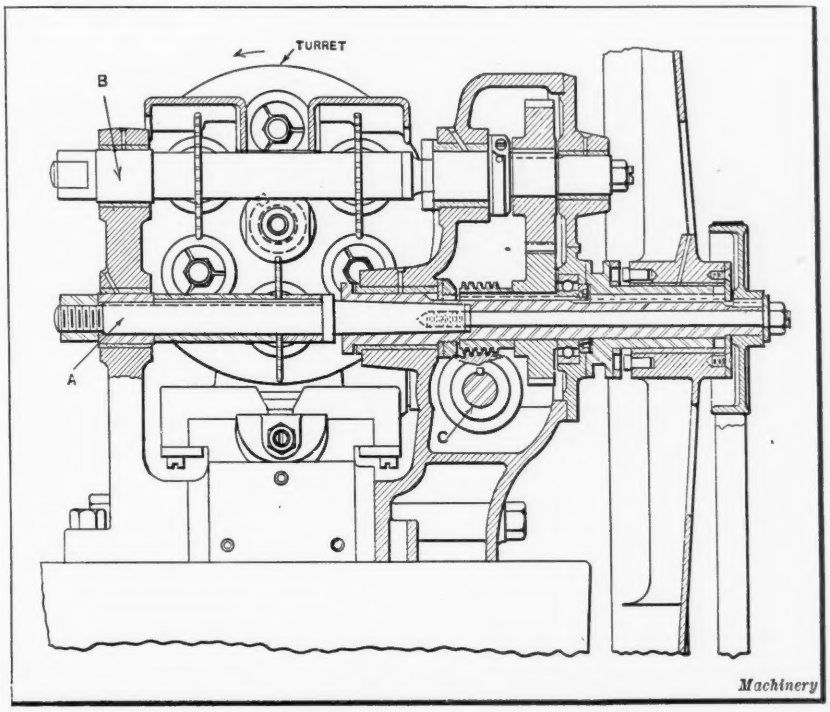


Fig. 2. Cross-section showing Method of driving the Cutter-arbors and the Camshaft

E, causing pawl *F* to engage one of six pins on the index-plate and revolve the turret through 60 degrees. As this movement is completed, the pawl at the rear again engages a notch in the index-plate and thus locks the turret.

A cut is taken on three of the six pieces in the turret with each feeding movement of the turret head. Thus there is an idle station between each working station. The top one of these idle stations is used for loading. When a collet reaches the loading position, a plunger in the bearing on top of the turret head, advances into contact with the ejector, opening the collet, and at the same time allowing a spring to force the adjustable stop forward and remove the work. When this movement has ended and the operator has pushed the ejector back again in loading the collet, the plunger is withdrawn by a spring within its bearing, after which the collet is drawn in and the work chucked through the action of a series of coil springs contained in a housing on the rear of the turret.

Cutting compound is pumped to the inside of the turret spindle from a tank in the pan surrounding the machine. Passages lead from this spindle to the rear of the collets for the delivery of the compound to them. By this arrangement the compound washes out all dirt or chips, and keeps the collets clean at all times. No compound is forced to the collets when they are in either the loading or idle positions.

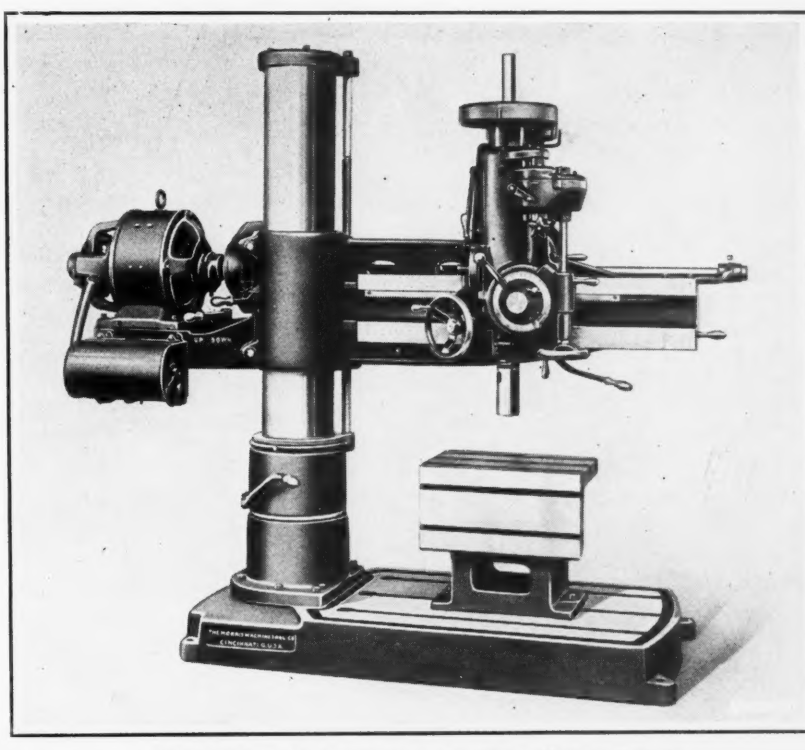
MORRIS RADIAL DRILLING MACHINE

In the radial drilling machine shown in the accompanying illustration, the driving motor is placed on the arm in back of the column. As a result of this design a power saving of from 20 to 25 per cent is claimed, and the number of machine parts is considerably reduced, with a consequent lessening of repairs. This machine has been recently added to the line of similar equipment built by the Morris Machine Tool Co., Cincinnati, Ohio. It is made in 4- and 4½-foot sizes. Another advantage of the design is that the motor serves to balance the arm and permits the arm to be raised and lowered on the column without straining the mechanism employed in accomplishing this. This mechanism is mounted as a unit on the back of the arm near the motor and is only in operation while the arm is being raised or lowered. The screw by means of which the up and down adjustment of the arm is obtained is always stationary.

The revolving unit of the machine is mounted on a ball thrust bearing of a capacity more than enough to carry the weight of the arm, head, motor and other details. A safety mechanism disengages the clutch which operates the arm raising and lowering mechanism when the arm reaches its extreme positions. The controller is mounted beneath the motor, within easy reach of the operator. The drill head has the same features as other radial drilling machines built by this concern, including a tapping attachment running in oil; back-gears and clutches made of nickel steel, and hardened; and helical spindle gears. All bearings are made of bronze and have an oil chamber to provide ample lubrication. The spindle speeds range from 26 to 450 revolutions per minute. A 3½-horsepower motor is required for driving the machine.

SNELLEX AUTOMATIC CENTERS

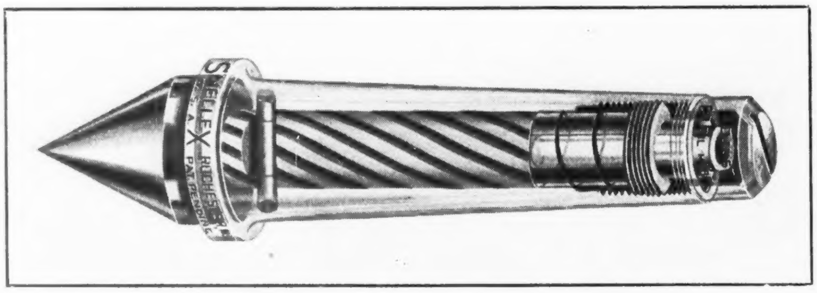
Difficulties met with in supporting work between the centers of lathes and grinding machines may be reduced by means of anti-friction and anti-expansion centers produced by the Snellex Mfg. Co., Rochester, N. Y. The anti-expansion center is here illustrated. It is intended for use on the headstock of a lathe to compensate for the pressure caused by the expansion of work during its machining thus eliminating the necessity of adjusting the position of the tailstock center during an operation. This center obviates the expansive force by withdrawing into its sleeve, this movement being limited by a stop-pin. An adjustable spring equalizes the cutting pressure. It is necessary to



Radial Drilling Machine built by the Morris Machine Tool Co.

supply the center with oil only about once in six months.

The anti-friction center is intended for use on the tailstock to eliminate friction on the center and thus prevent burning of centers. It is similar in design to a center made by the same concern which was described in MACHINERY, for November, 1920, except that the balls of the race near the front are about three times larger in volume than on the original center, the size being increased to carry heavier loads. Also, the cone now has a push-fit assembly and is provided with a key instead of a lock washer. The adjusting nut is split so as to clamp itself tightly on the thread, and is made long enough to project from the sleeve for adjusting by means of a special wrench.



Anti-expansion Center placed on the Market by the Snellex Mfg. Co.

NEWTON RADIUS-LINK GRINDING MACHINE

Grinding the curved surfaces of reverse or radius links and blocks is one of the comparatively few precision operations performed in locomotive building and repair shops. To facilitate this work and to permit the grinding of other parts on which the surfaces to be ground have a radius of between 18 and 100 inches, the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., have developed the machine shown in the accompanying illustration. The reciprocation of the table is controlled automatically by dogs. This reciprocatory motion incorporates a period of dwell to permit the operation of the vertical wheel feed and the removal of pressure during the reversal of the table. The radius at which the table reciprocates is governed by the position of a pivot bearing, which may be positioned along the radius-bar by means of a rack and pinion. A scale indicates the radius for which the machine is set at any time. The radius-bar is a tube 4 inches in diameter. The slide on which the table is mounted is fitted at both ends with a cast-iron shield to protect the surface on which the table slides. The top surface of the table contains three machined T-slots.

The spindle has a taper end and is provided with ball bearings. The driving pulley is carried on separate ball bearings so that there is no thrust other that that obtained by rotation. The spindle sleeve has a 3-inch adjustment in the slide. The slide is counterweighted and is adjusted by hand. It has an oscillating motion for wide-faced wheels and an intermittent feeding motion for narrow-faced wheels. This latter motion is reversible by means of a ratchet box. The spindle head is adjustable on the upright for regulating the depth of cut, and has a sufficient movement to permit the grinding of blocks as well as links.

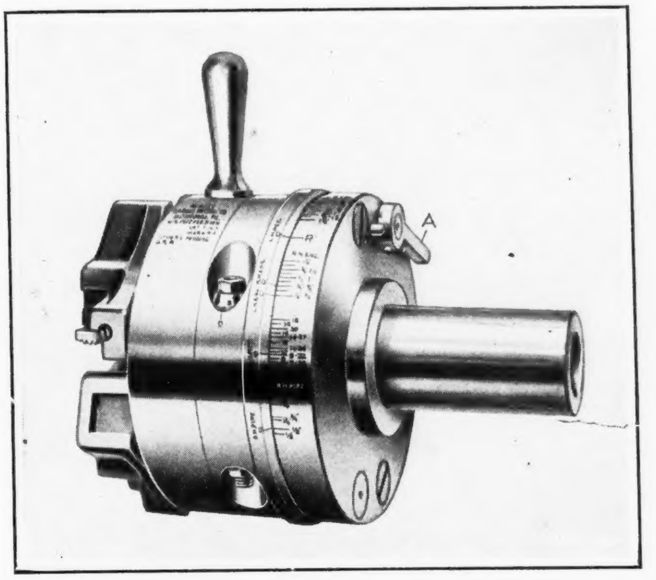
A wheel-truing device is arranged in such a manner that the motion of the spindle slide is utilized for truing the wheel. The truing device can be readily swung out of position when not in use. The machine may be driven by a 5-horsepower motor or by a single-pulley drive.

Some of the principal specifications of the machine are as follows: Spindle speed, 6000 revolutions per minute; minimum and maximum distance from center of spindle to column, 7 and 13 inches, respectively; vertical movement of spindle slide, 8⅝ inches; minimum and maximum height from spindle flange to table, 7 and 18⅝ inches, respectively; dimensions of table surface, 42 by 18 inches; minimum and maximum table stroke, 2 and 30 inches; and table speeds, 5 feet 3 inches, 7 feet 10 inches, and 10 feet 6 inches per minute.

LANDIS AUTOMATIC DIE-HEADS

An automatic screw-cutting die-head in which the chasers were supported on the face of the head was described in June, 1919, MACHINERY, at the time the tool was brought out by the Landis Machine Co., Inc., Waynesboro, Pa. This die-head was later withdrawn from the market, and after being redesigned, as shown in the accompanying illustration, it is again being introduced in five sizes, of which the 1¼-, 2- and 3-inch sizes are identical with the die-head illustrated. The ⅝- and ⅞-inch sizes are also automatic but are some-

Locomotive Reverse Link and Block Grinding Machine produced by the Newton Machine Tool Works, Inc.



Improved Automatic Die-head brought out by the Landis Machine Co.

what different, as will be mentioned later. This die-head is applicable to practically all makes of screw machines and turret lathes having a sufficient swing.

The original design was locked by the operating handle, which contained a latch having a tongue milled off center on the lower end. To adjust this head for taking either a roughing or a finishing cut, it was necessary to turn the latch to certain graduations. The new die-head is locked by engaging two hardened cylindrical pins in hardened bushings. Both roughing and finishing cuts can be taken with the three larger sizes of die-heads mentioned by moving the lock pin lever *A*, attached to one of the pins. The die-heads are opened automatically and closed by hand.

When cutting threads with one pass of the die-head, both lock-pins are engaged, but when cutting threads with two passes, both lock-pins are engaged for the first cut, and only that to which the lock-pin lever is attached, for the second cut. The lock-pins are machined eccentrically.

The die-head is adjustable to size by means of a screw which engages the body. The operating, adjusting, and closing rings remain in a fixed position when the head is closed, and thus, by rotating the head body within these rings, the die-head may be set to the diameters within its range. It is graduated for all sizes of right- and left-hand bolts and right-hand pipe, within its range. In setting the old-style head for left-hand threading, it was necessary to remove a screw that locked the latch pin and rotate the latter to a left-hand graduation, after which the screw was replaced and left-hand holders attached. To adjust the new die-head of the larger sizes for left-hand threading, the position of the lock-pin lever is simply reversed.

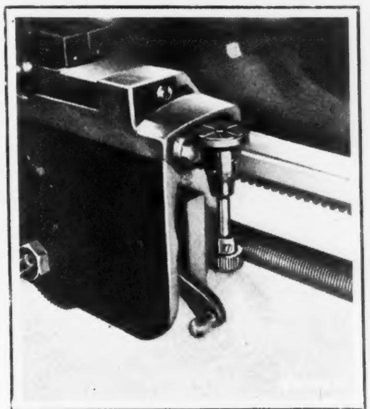
On the 5/8- and 7/8-inch die-heads the chaser and trunnions are integral. These die-heads are not provided with roughing and finishing attachments. The one set of chaser holders furnished is suitable for threading bolt and pipe within its range. Each chaser-holder and trunnion may be easily taken out of the die-head to substitute holders for special threads, by merely removing the shank and loosening one screw. The 5/8- and 7/8-inch sizes do not have the lock-pin lever. The chaser-holders and trunnions furnished with the 1 1/4, 2-, and 3-inch die-heads are separate. These sizes are regularly supplied with right-hand bolt chaser-holders for cutting U. S. standard threads but they may also be equipped for cutting S.A.E., vee, metric, Whitworth, and Briggs standard threads.

COLVEN THREAD-CHASING DIAL

Many modern lathes are equipped with a thread-chasing dial that facilitates the return of the carriage by hand to the starting point after each cut. For use on lathes not so equipped, James M. Colven, 20 Wolffe St., Yonkers, N. Y., is placing on the market the "E-Z" chasing dial illustrated. It consists essentially of a bracket attached by means of two machine screws to the rear end of the carriage on the front side. This bracket supports a vertical shaft, having a graduated dial at the upper end and a bronze worm-wheel at the lower end which meshes with the lead-screw. The worm-wheel is protected by a suitable cover. There are eight graduations on the dial, four of which are numbered and four unnumbered.

The number of teeth on the worm-wheel is a multiple of the number of threads per inch on the lead-screw, and the number of main divisions on the dial equals the number of teeth on the worm-wheel divided by the number of threads per inch on the lead-screw. Thus each main division, or the distance between two numbered or two unnumbered graduations, represents an inch of carriage travel. In re-engaging the carriage with the lead-screw, after having returned the carriage to the approximate starting point, it is only necessary to watch the dial and immediately close the apron half-nuts on the lead-screw as the proper graduation registers with a line scribed on the dial bracket.

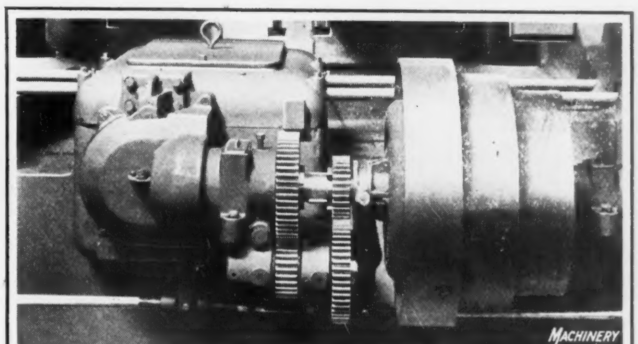
In cutting an even number of threads per inch, the nuts may be closed when any one of the dial graduations comes into alignment with the line on the bracket, but when cutting an odd number of threads per inch, only the numbered graduations are employed. In cutting 11 1/2 threads per inch, or a similar number, if the dial is set to Line 1 when beginning the first cut, the following cuts can be taken by closing the apron half-nuts when the dial is either at Line 1 or 3 until the thread is finished. The device is equally adaptable to right- and left-hand, external and internal threads. The cutting of threads close to a shoulder can be readily accomplished with this device, because the operator does not have to shift the driving belt each time the end of the thread is reached. On a lathe equipped with the dial, work may be removed for fitting into the part with which it is to be used and then easily replaced between the centers for taking additional cuts.



Thread-chasing Dial made by James M. Colven

CINCINNATI SLOW-SPEED DEVICE FOR BORING MILL

A slow-speed device has been designed by the Cincinnati Planer Co., Cincinnati, Ohio, for application to a 7-foot boring mill built by this company which was arranged for operation at a speed 30 per cent greater than standard. The machine was built for handling locomotive driving



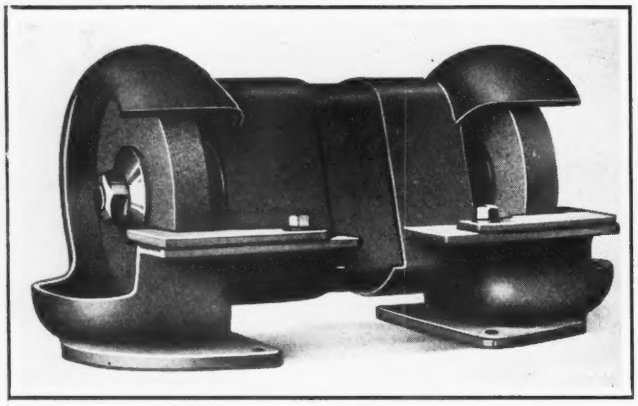
Slow-speed Device for Boring Mill which has been brought out by the Cincinnati Planer Co.

boxes and other brass parts. By means of the slow-speed device, the speed of this machine may be reduced to about 2/3 of a revolution per minute so as to also adapt the machine to the turning of tires. The accompanying illustration shows the gears of this device in mesh for driving the machine at the slow speed. The regular boring mill speeds are obtained through a direct drive when the small upper gear is slid to the left to bring its clutch teeth into mesh with those of the larger gear on the same shaft.

The friction clutch to the right of the gearing is the standard equipment for starting and stopping the boring mill. Ordinarily this clutch drives the machine through bevel gears without any of the spur gears shown. In this case the shaft is made short and the bevel gear bearing is merely used as a support. A cover which protects the gears carries a shifter for moving the sliding gear to and fro.

FORBES & MYERS TOOL GRINDER

In order to have the motor as large as possible without interfering with the grinding of long work and without destroying compactness of the design, Forbes & Myers, 178 Union St., Worcester, Mass., have provided a motor with windings only on the rear side, on the tool grinder illustrated. The motor is of the squirrel-cage induction type. As a result of this design the 6-inch wheels with which the grinder is equipped, project $1\frac{1}{4}$ inches beyond the front of the motor housing. Thus, three-quarters of the wheels may



Tool Grinder made by Forbes & Myers in Bench and Floor Types

be worn away before the periphery comes on a line with the housing. The design also permits the grinding of parts on both sides of the wheels.

The wheels that are regularly supplied are suitable for grinding tool steel; however, other grades may also be furnished. The spindle is $\frac{3}{4}$ inch in diameter at the wheels and revolves in Norma annular ball bearings which are fully enclosed. The wheel flanges are comparatively large in diameter and bear only at the outer edge. The tool rests are adjustable in two directions. The motor is of $\frac{1}{2}$ horsepower, runs 3600 revolutions per minute and is fully enclosed. It can be furnished for operation on 2- or 3-phase, 60-cycle current of 110-, 220-, 440-, or 550-voltage. The bench model weighs 35 pounds, and the floor stand type, 140 pounds.

NORTON GRINDING MACHINES

Four grinding machines, one of the surface type and three of the cylindrical type, particularly adapted to the grinding of automobile parts, have been recently developed by the Norton Co., Worcester, Mass., and are presented in the accompanying illustrations. In Fig. 1, the surface grinding machine is illustrated. It is of the open-side design and has a table surface of 6 by 36 inches, on which work up to $8\frac{1}{2}$ inches in width may be ground. The maximum distance from the table to the under side of the wheel is $10\frac{1}{4}$ inches. Attention is called to the fact that it has an improved

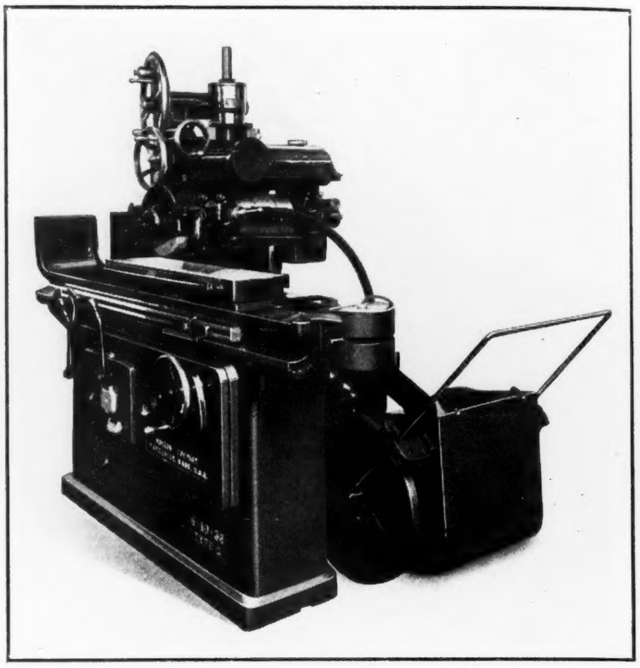


Fig. 1. Newly designed Surface Grinding Machine developed by the Norton Co.

spindle bearing construction having thumb-screw adjustments and flooded lubrication. It is said that the spindle requires no attention after the thumb-screws have been adjusted, provided the spindle is rotated at its normal speed. The machine has a rapid table traverse for enabling high rates of production to be obtained. A hand table traverse is automatically engaged when the power traverse is disengaged. A 15-horsepower motor mounted on the base drives the machine. The grinding lubricant is pumped from a portable tank which can be cleaned in a few minutes without requiring interruption of the machine operation.

Some of the principal specifications of the machine are as follows: Index feed for vertical slide, 0.00025 inch; speed of table, $80\frac{1}{2}$ feet per minute; dimensions of grinding wheel. 10 by 3 inches; surface speed of wheel, about 3500 feet per minute; speed of wheel-spindle, about 1340 revolutions per minute; diameter of driving shaft and spindle pulleys, 14 inches; width of the motor driving belt, 5 inches; and weight of machine, approximately, 6500 pounds.

A 10- by 18-inch plain cylindrical grinding machine is shown in Fig. 2. This machine is similar to the regular Norton 10-inch cylindrical grinding machines except that the distance between the centers has been shortened to particularly adapt the machine to grinding automobile parts.

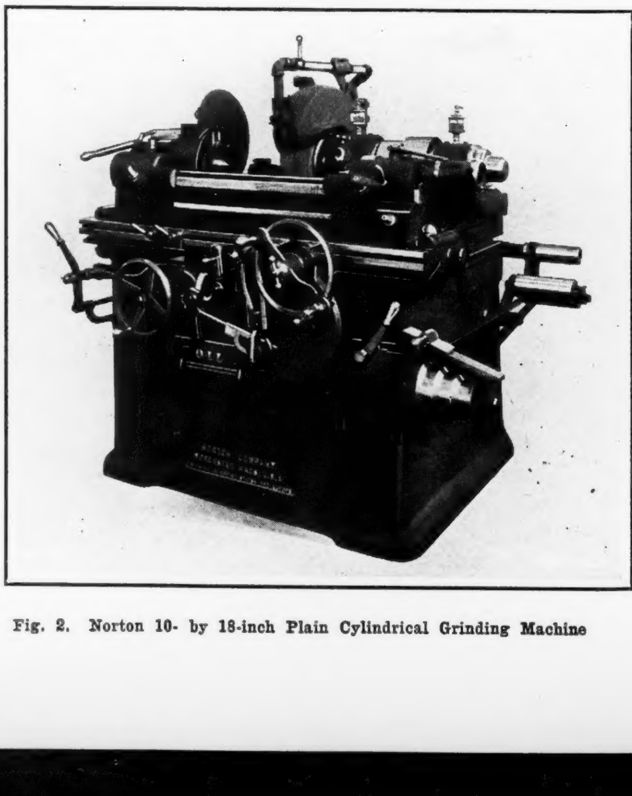


Fig. 2. Norton 10- by 18-inch Plain Cylindrical Grinding Machine

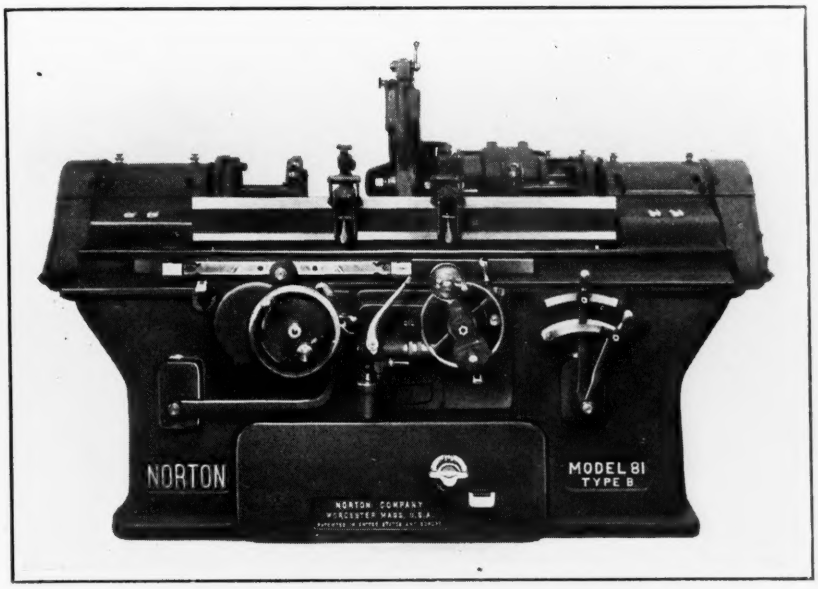


Fig. 3. Norton Model 81 Type B Crankpin Grinding Machine

The headstock, footstock, wheel-slide, and table- and wheel-feed mechanisms are the same as on the 10-inch machines.

A Model 81 Type B crankpin grinding machine is illustrated in Fig. 3. This machine has six work-speeds secured through heat-treated sliding gears which run in an oil bath. An automatic power in-feed, which is independent of the work-speed, provides a means of feeding the wheel to suit each individual crank being ground. The apron has a two-speed hand table traverse, the slower of which is used in truing. The faster speed is utilized for moving the table from one pin to another. A safety mechanism renders it impossible for the operator to injure the wheel or the work by feeding the wheel too suddenly when commencing to grind the pin. The wheel-spindle is of an improved type provided with flooded lubrication and a thumb-screw adjustment. This machine is built in four sizes weighing from about 11,400 to 11,600 pounds, this weight including the 25-horsepower motor by which each size is driven.

In Fig. 4 is illustrated a Norton 18- by 72-inch "Autopart" regrinding machine equipped with a power table traverse and arranged for a motor drive. This machine has been developed to meet the demands of regrinding shops in which there is not sufficient crankshaft work to keep busy the standard 18- by 55-inch "Autopart" regrinding machine that was described in MACHINERY for June, 1921. By adding the power table traverse, the machine is also suitable for ordinary cylindrical grinding operations. The dimensions of the wheel-slide, headstock, footstock, and other important members of this machine are the same as for these parts on the standard machine. The latter may also be equipped with a power table traverse and either a belt or motor drive.

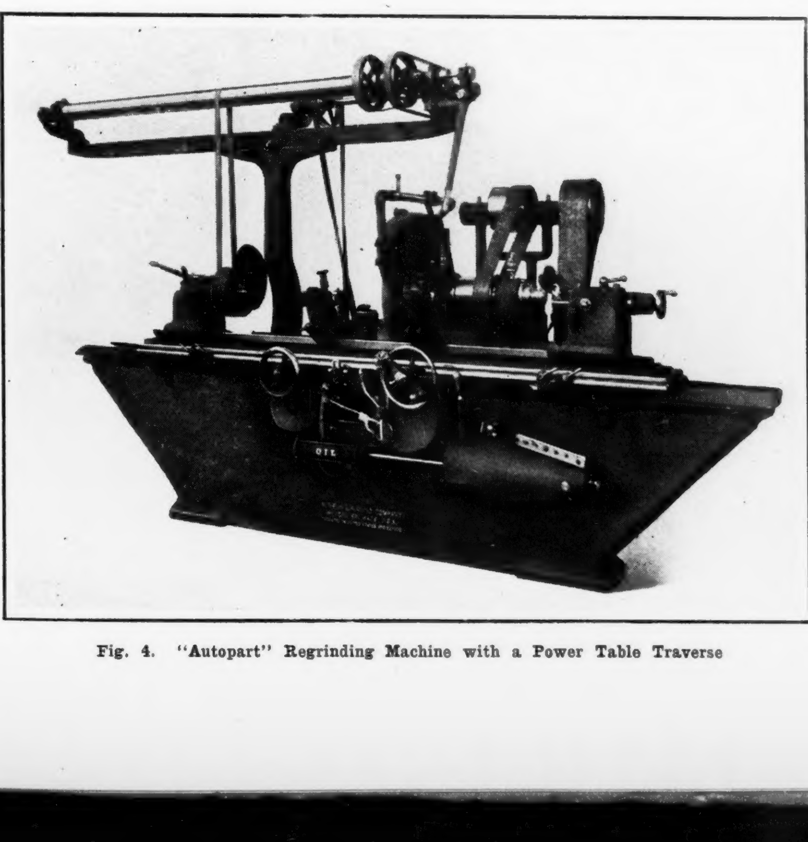
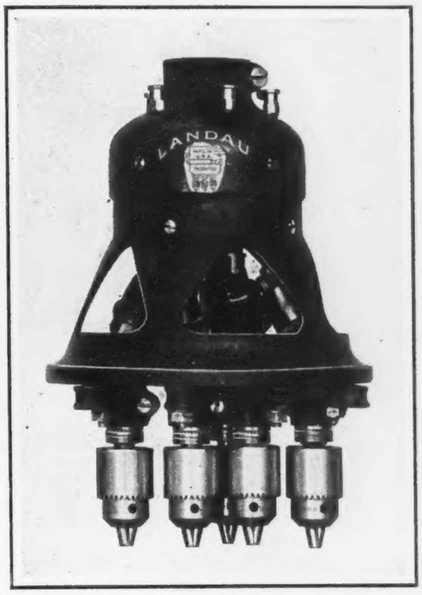


Fig. 4. "Autopart" Regrinding Machine with a Power Table Traverse

LANDAU DRILLING AND TAPPING MACHINE

A sensitive multiple-spindle drilling and tapping machine, equipped with a head having five spindles which may be instantly and individually adapted for drilling or tapping without adding or removing parts, is now being built by the Landau Machine & Drill Press Co., 45 W. 18th St., New York City. This machine, except for the head, is similar in design to a machine brought out by the same company several years ago. On the former machine the head had four spindles, and could be indexed for performing a series of operations on one hole, such as drilling, tapping, reaming and countersinking. The head on the new machine is of the design shown in the accompanying illustration. It has a capacity for drilling holes up to ¼ inch in diameter and tapping holes up to No. 10–32.



Landau Multiple-spindle Drilling and Tapping Head

The main spindle of the head is centrally located and mounted on ball bearings. The drilling and tapping spindles are adjustable relative to the center of the head by means of arms. In order to arrange a spindle for tapping when it has been employed for drilling, and vice versa, it is only necessary to loosen a set-screw. Any of the spindles can be used for tapping while the others are being used for drilling. When all the spindles are not required in an operation, those that are not to be used can be kept stationary by a simple adjustment. Each spindle may be adjusted vertically to suit short drills and taps. Upper and lower ball bearings reduce friction on the spindles. The head is fed through a rack and pinion.

Three spindle speeds of 500, 900, and 1800 revolutions per minute are obtainable by operating the belt shifter. The withdrawal speeds in tapping are 600, 1000, and 1800 R. P. M. Some of the specifications are as follows: Minimum and maximum spread of spindles, ⅞ and 4½ inches, respectively; distance from center of spindle to column, 8 inches; travel of head, 3½ inches; travel of table, 9 inches; weight of belt-driven machine, 300 pounds; and weight of motor-driven machine, 360 pounds.

ELWELL-PARKER CRANE TRUCK

The latest addition to the line of trucks built by the Elwell-Parker Electric Co., Cleveland, Ohio, is an electric truck having a revolving crane mounted as shown in the accompanying illustration. This equipment has a lifting capacity of 3000 pounds at a 6-foot radius and 1000 pounds at a 12-foot radius. It stacks 12 feet in height with the boom set for lifting 3000 pounds. The truck is of a heavy construction which provides sufficient stability when lifting, and absorbs the strains imposed. A single-motor double-drum hoisting unit handles a separate line to the boom and hook. The motor hoisting unit serves to counterbalance the boom and its load. The crane column is supported on a heavy pillar and revolves on ball and roller bearings. It may be swiveled through 180 degrees. The boom may be locked in any desired position and, when lowered, permits

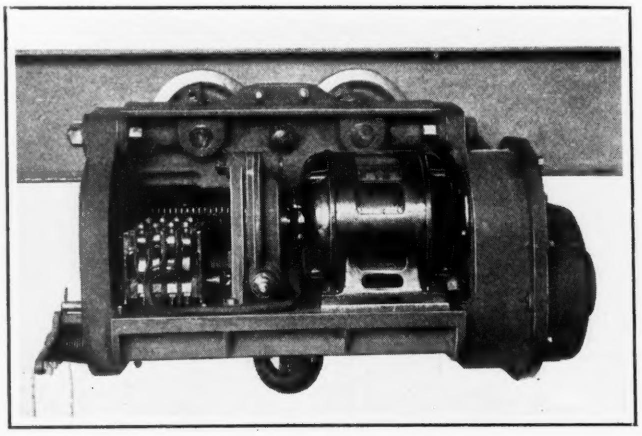
Industrial Crane Truck recently added to the Line of Equipment built by the Elwell-Parker Electric Co.

the truck to pass through a 6-foot doorway. A single battery furnishes power for the two motors of the truck. The controllers for these motors are in front of the operator. Such safety features as a crane trip switch, automatic control, worm-drive and pressure lubrication system, are incorporated in this truck.

STANDARD "SHORT HEAD-ROOM" ELECTRIC HOIST

An important consideration in many hoist installations is the amount of head room required for the hoist. This factor was kept in mind by the Standard Electric Crane & Hoist Co., 1420 Chestnut St., Philadelphia, Pa. in bringing out a "Short Head-room" monorail electric hoist which is built in 1-, 2-, 3-, 4-, and 5-ton capacities. On the 3-ton size, for example, the head room is only 14 inches. In the accompanying illustration the hoist is shown with one cover removed in order to give an idea of the compact arrangement of the different units. The lifting hook is shown in its highest position.

All shafts are made of high-carbon steel, heat-treated and ground to size and have roller bearing races pressed on the ends. The bearings are of the Hyatt high-duty type. Spur gears made from forged steel are used for the drive, these gears being contained in the end housing. The pinions are made of high-carbon steel and heat-treated. The cable



"Short Head-room" Monorail Electric Hoist manufactured by the Standard Electric Crane & Hoist Co.

grooves of the hoisting drum are machine-turned and coil the rope in a single layer. The cable is connected to the exterior of the drum in a simple manner and can be easily replaced. The controller is built especially for hoisting service with all parts fireproof and completely protected from dust and moisture. The motor is of a standard make, fully enclosed and guaranteed against overheating during a half hour's continuous run. It is equipped with ball bearings.

An automatic mechanical brake controls the lowering speed and another automatic brake applied on the pulley on the motor shaft and operated by a cam on the controller shaft, safely holds the load at any desired point. A device breaks the electric current and applies this holding brake when the load block reaches its upper limit of travel. Either a 2- or 4-part rope block is supplied. All gears operate in a bath of oil and automatically splash the main bearings. Bearings not oiled in this manner are lubricated by the Alemite system.

LANDAU PLAIN AND BACK-GEARED TAPPING CHUCKS

Three of a line of plain and back-geared tapping chucks recently placed on the market by the Landau Machine & Drill Press Co., 45 W. 18th St., New York City, are illustrated in Figs. 1 and 2. The back-geared chuck shown at the right in Fig. 1 is known as Model E. Its main spindle

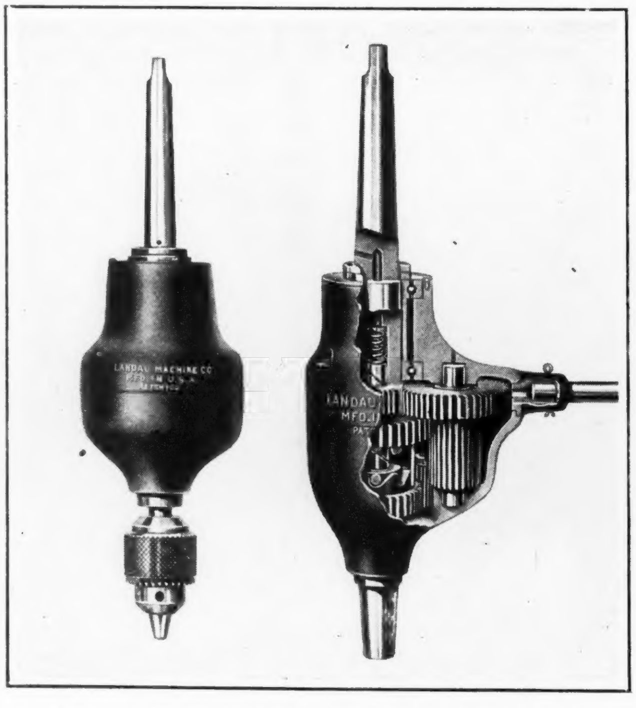


Fig. 1. Models B and E Tapping Chucks manufactured by the Landau Machine & Drill Press Co.

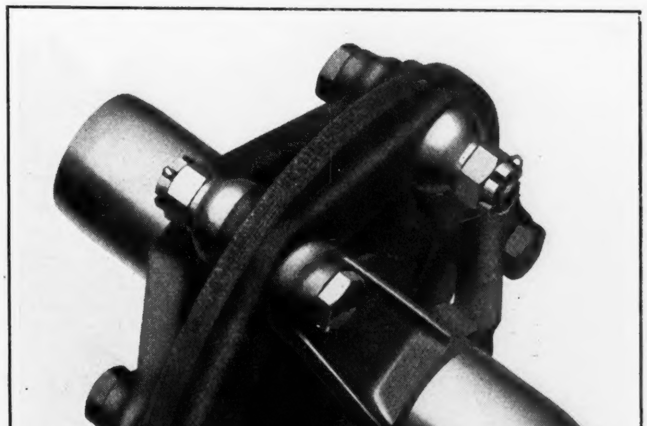
Fig. 2. Model G Tapping Chuck

revolves on ball bearings. In using this attachment, the tapping spindle remains stationary after the tap comes into contact with the work, until the teeth of the upper driving clutch are brought into mesh with a pin on the tapping spindle. The latter is then rotated in the proper direction for tapping the hole. When this operation has been completed and the machine spindle is raised for withdrawing the tap from the hole, the tapping spindle again remains stationary until the teeth of the lower clutch of the attachment are raised into engagement with the spindle driving pin. The tap is then revolved in the proper direction for withdrawing it from the work. The Model E chuck will tap holes up to 7/16 inch, and the Model F, which is similar in design, has a capacity for tapping holes from 3/8 to 1 1/8 inches in diameter. The Model B tapping chuck shown at the left in Fig. 1 has a capacity for taps up to a 1/4 inch.

In Fig. 2 is shown a Model G plain tapping chuck which is equipped with a friction device that slips and permits the tap to stop advancing whenever a hard spot is encountered in tapping, thus preventing breakage of the tap. As illustrated, this chuck is provided with a straight shank and a sleeve which adapts it to use on a turret lathe. It is also furnished with a taper shank for use on drilling machines and engine lathes.

CLIMAX CORD DISK COUPLING

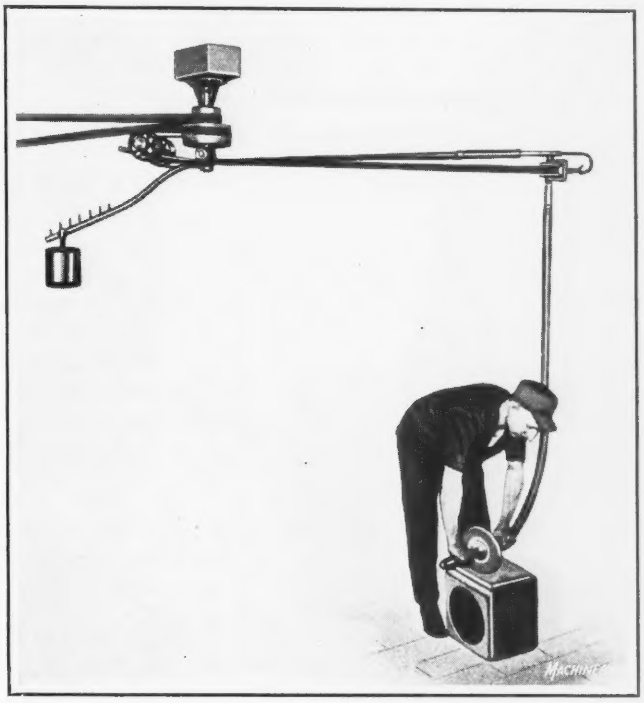
A flexible coupling intended both for use in the lineshaft installations of a shop or in the power transmitting shafts of machine tools, has been recently produced by the Climax Motor Devices Co., Chagrin Falls, Ohio. This coupling receives its flexibility from disks and cords wound in link form from bolt hole to bolt hole, thus forming a continuous reinforcing chain. Both disks and link cords are made from cotton duck. Semi-spherical projections at the bolt holes fit into the cup-shaped spider arms and cup washers. This


Cord Disk Coupling manufactured by the Climax Motor Devices Co.

arrangement prevents loosening of the bolts which hold the two sections of the coupling together. The flexibility compensates for all direct or angular misalignments of shafting and also absorbs shocks. This coupling is made in four sizes which have a disk diameter of 5 1/2, 6 1/2, 7 1/2, and 9 inches, respectively, and a capacity, at a speed of 100 revolutions per minute, of 1, 2, 4, and 6 horsepower, respectively.

STOW FLEXIBLE RADIAL GRINDER

A grinder intended for being driven directly from a lineshaft and having a flexible shaft at the end of an extension arm which may be swiveled to permit the use of the grinder on parts located on the floor around the equipment, is shown in the accompanying illustration. This grinder is made in five sizes by the Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y. The flexible shaft is counterbalanced by a

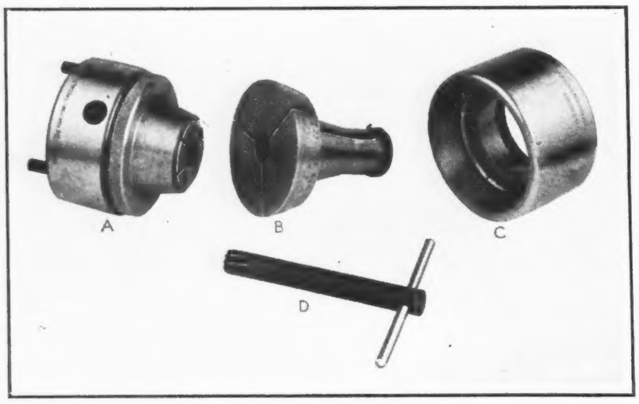

Flexible Radial Grinder made by the Stow Mfg. Co., Inc.

weight. The entire unit hangs from the ceiling, and may be driven by a motor instead of from a lineshaft as shown. In addition to being supplied for grinding operations, this equipment may be furnished with drill wire scratch brush attachments. It also serves as a convenient assembling tool when equipped with a screwdriving attachment.

HARTFORD COMBINATION COLLET AND STEP CHUCK

The different parts of a combination collet and step chuck manufactured by the Hartford Special Machinery Co., Hartford, Conn., for application to engine and turret lathes and screw, milling and grinding machines, etc., are presented in the accompanying illustration. At *A* the device is arranged as a collet chuck for attaching to an ordinary chuck faceplate. The collets are made to cover a range of work from 3/16 to 1 inch in diameter. In arranging the device as a step chuck, the knurled ring which is used to protect the thread is removed from the nose of the chuck and the collet withdrawn. The step member shown at *B* is then substituted for the collet and the closer member at *C* screwed on the threads from which the ring was removed.

The design of the collet is such that the gripping portion always seats on a straight line regardless of whether the diameter of the work varies as much as 1/32 inch from the nominal size of the collet hole. Several of the advantages

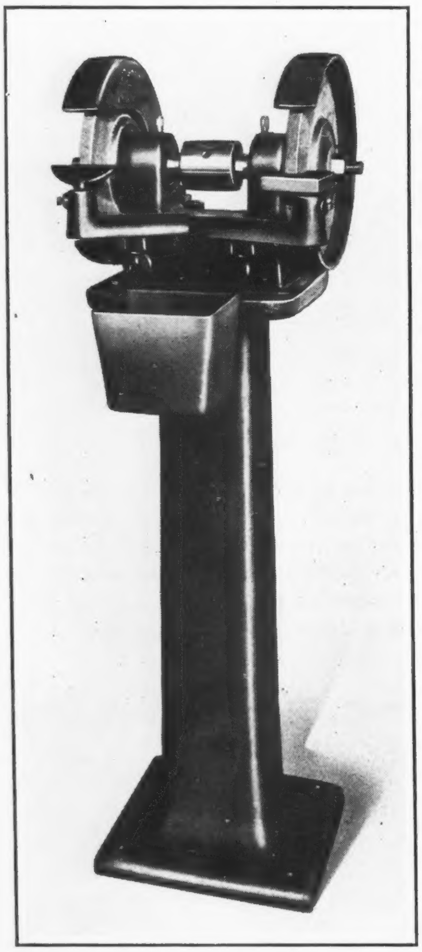


Parts of Combination Collet and Step Chuck made by the Hartford Special Machinery Co.

claimed for this chuck are that it is not necessary for the machine operator to leave his position at the front of the machine in order to tighten or loosen the chuck; a tight grip is readily obtained; and collets up to the full size of the hole through the spindle may be used.

FAFNIR BALL-BEARING TOOL GRINDER

In many machine shops the tool grinder is a source of annoyance to foremen, because those using it often neglect to stop it when they are through grinding. It was the aim of the Fafnir Bearing Co., New Britain, Conn., in developing the grinder here illustrated, to produce an equipment that could be run continuously by connecting to a lineshaft, without undue wear. The principal feature is the mounting of the grinding wheel spindle in ball bearings. The machine is driven through a pulley which is mounted on the wheel-spindle between the two ball bearings. The grinder may be supplied with a plate, instead of a pedestal for mounting on a bench, or with an offset bracket for bolting to a convenient post. It will be observed that the machine is equipped with a water pot, grinding - wheel guards, and adjustable tool-rests.

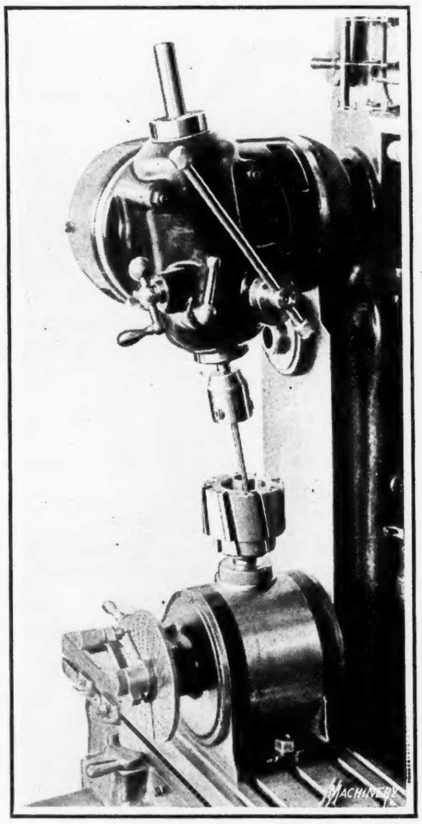


Tool Grinder built by the Fafnir Bearing Co.

ROCKFORD UNIVERSAL MILLING AND DRILLING ATTACHMENT

An attachment has recently been brought out by the Rockford Milling Machine Co., Rockford, Ill., for machines of its manufacture, which permits of milling angular surfaces or drilling holes at an angle. The illustration shows the attachment being used for reaming a taper hole in a cutter-head. The attachment is clamped to the face of the machine column, and driven by gears from the back of the main spindle through a driving sleeve substituted for the regular overhanging arm. The spindle of the attachment is driven from this sleeve through bevel gears. This driving arrangement leaves the main spindle of the machine free for use, and on many jobs it is possible to mill with a cutter in the main spindle at the same time that angular drilling or milling is being performed.

The attachment has two graduated bases located at right angles to each other, both of which can be swiveled through 360 degrees. This construction makes the spindle universal, as it can be set in any position. The spindle sleeve is graduated in inches and has an adjustment of 5 inches to increase the vertical range. Adjustments provide for compensating for wear of both upper and lower spindle sleeve bearings. The spindle is made of crucible steel, accurately ground, and runs in phospher-bronze bearings fitted with felt for retaining oil. The spindle end is bored to a No. 9 B & S taper.

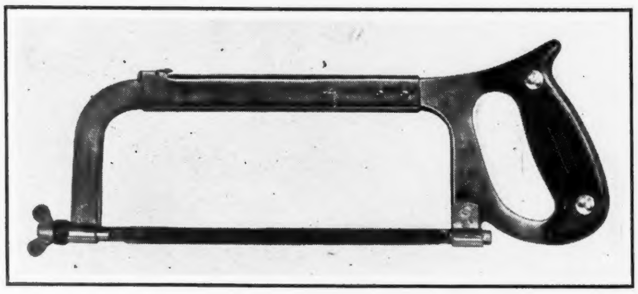


Rockford Universal Milling and Drilling Attachment

A rack and worm feed provides for boring to close limits. This feed is obtained by loosening a thumb-screw and moving the drill handle sleeve. It is in the ratio of 48 to 1, and thus permits a feed 1/48 that of the hand feed. The worm-feed handle is located at the front of the attachment within easy reach of the operator. Sixteen spindle speeds ranging from 21 to 414 revolutions per minute are obtainable and drills from 3/16 to 1¼ inches in diameter can be used. A drill chuck can be furnished.

STARRETT PISTOL GRIP HACKSAW FRAME

A number of interesting features are incorporated in the design of a new adjustable pistol-grip hacksaw frame lately brought out by the L. S. Starrett Co., Athol, Mass. On this frame a constant spring tension is maintained on the bolts



Pistol-grip Adjustable Hacksaw Frame manufactured by the L. S. Starrett Co.

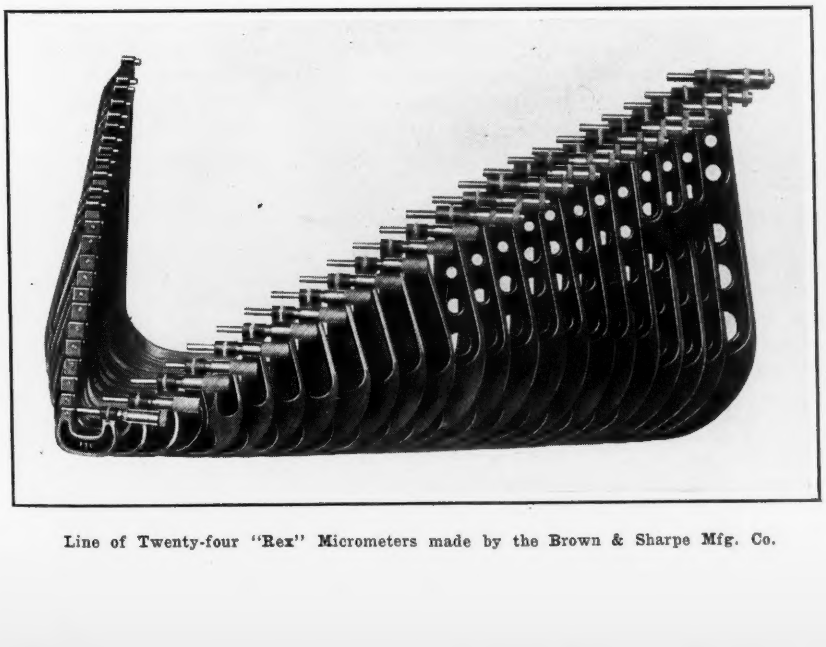
which hold the blade, and this, in connection with a positive adjustment on the back which permits the use of blades from 8 to 12 inches in length, facilitates changing the blades. The pawl for adjusting to suit the length of blade is set into the frame as low as possible so as not to mar the appearance of the frame. The back is constructed of steel tubing, and all steel parts are nickel-plated. The blade may be set in any one of four positions by turning the wing-nut. It is not necessary to remove this nut entirely in order to position the blade as mentioned. The frame has a depth of 3⅜ inches from the cutting edge of the blade. The handle is made of hard rubber and checked to provide a good grip.

ATLAS "MIKRO-INDICATOR" CYLINDER AND PISTON GAGES

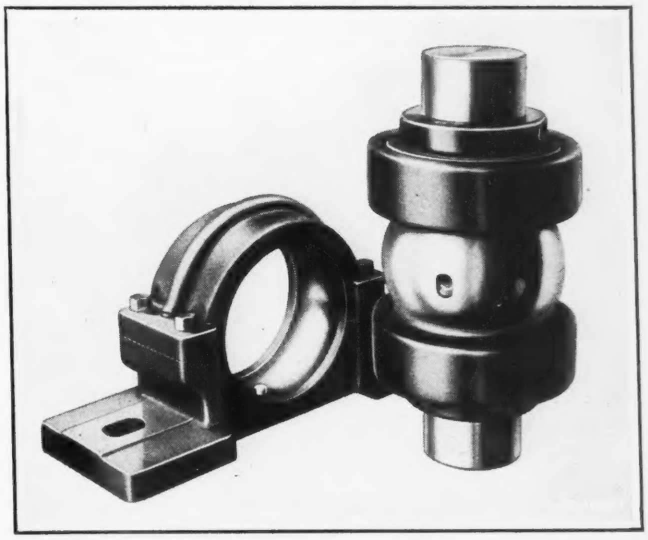
Two gages for detecting inaccuracies of automobile pistons and cylinders have been recently placed on the market by the George H. Wilkins Co., 180 N. Market St., Chicago, Ill. Both gages are equipped with an Atlas "Mikro-indicator." The cylinder gage consists of the indicator which has two contact points and a saddle having a stud upon which the indicator is supported. In testing the bore of a cylinder, the saddle is held firmly against the wall by means of a handle and is slid along the wall. Variations are shown in thousandths of an inch, and diameters from 2⅝ to 5 inches may be checked. This gage may also be used for testing turned work in a lathe, crankshaft bearings in a truing fixture, etc. The piston gage is of a bench type and is intended for rapidly checking the diameter of pistons, piston-rings, and other cylindrical parts having a diameter up to and including 6 inches. The gage has a scale for indicating the approximate diameter of the part, and the indicator shows the slight variations.

BROWN & SHARPE "REX" MICROMETERS

A new line of "Rex" micrometers made for both English and metric measure are now being announced by the Brown & Sharpe Mfg. Co., Providence, R. I. This line includes 24 sizes of micrometers for taking measurements up to 24 inches or 600 millimeters. The illustration shows the complete line in progression from the No. 59 micrometer which measures up to 1 inch, to the No. 88 micrometer which measures from 23 to 24 inches. These micrometers are regularly furnished with a ring for clamping the spindle and preserving its setting. Holes are provided in the frames of the larger sizes of micrometers to lighten them. The anvil, spindle, and other parts of this line are similar to the members furnished on the regular B & S micrometers. Means are provided to compensate for wear of measuring surfaces and the adjusting screw.



Line of Twenty-four "Rex" Micrometers made by the Brown & Sharpe Mfg. Co.



Double Ball-bearing Self-aligning Pillow-block made by the Fafnir Bearing Co.

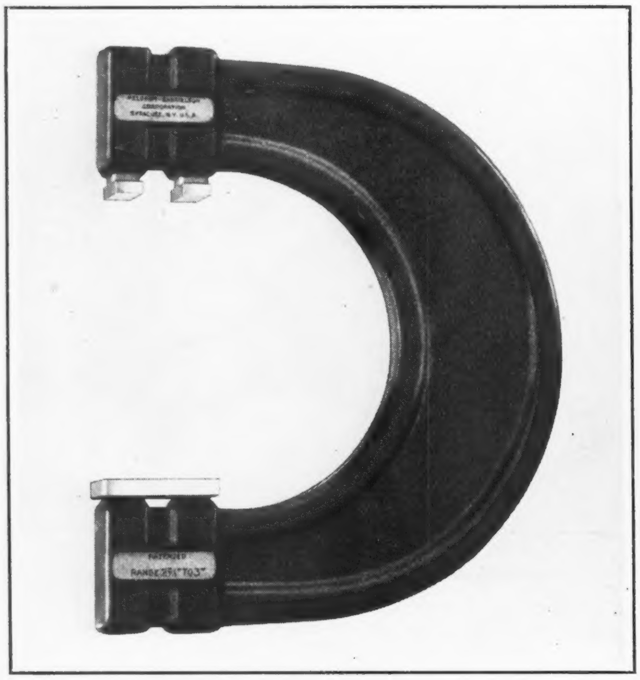
FAFNIR SELF-ALIGNING PILLOW-BLOCK

Both radial and end thrusts are taken by ball bearings in the double ball-bearing self-aligning pillow-block shown disassembled in the accompanying illustration. This pillow-block has been recently produced by the Fafnir Bearing Co., New Britain, Conn. It aligns itself to compensate for any discrepancies between the surface on which it rests and the position of the shaft that it supports. This self-alignment has no effect on the ball bearings, as they are installed in a box which aligns as a unit. Each unit has two Fafnir transmission ball bearings which have a radial ball contact and deep race grooves. The inner ring of the bearings is extra wide in order to give the bearing a firm seat on the shaft and to afford the shaft a greater support. The outer ring is mounted against a shoulder in the box. An end cap is held in place by a steel wire snapped into a groove machined in the housing. This cap contains a felt washer which prevents the escape of lubricant or the entrance of dirt.

The box is secured endwise on the shaft by collars clamped on the shaft by means of set-screws. These collars have lugs that mesh with corresponding slots cut in the wide inner rings of the ball bearings. Consequently the shaft, collars, and inner rings revolve together. The driving collars also transmit all end thrusts to the ball bearings. They abut against the inner rings, but do not come in contact with the housing or end caps. The installation of this pillow-block is an easy matter. The base can be bolted to the bed and the cap secured after the box and the shaft have been fitted in place. The shaft and box can also be removed without disturbing the base or the alignment. The shaft can be withdrawn by merely loosening the driving collars. The pillow-block may be adapted to special conditions by changing the spacing of bolt holes and the shaft center distance on the lower half of the unit.

MELDRUM-GABRIELSON ADJUSTABLE-LIMIT SNAP GAGE

A line of adjustable-limit snap gages manufactured by the Meldrum-Gabrielson Corporation, Syracuse, N. Y., was described in MACHINERY for October, 1921. Another gage now being manufactured by this concern is of the same general design but is provided with rectangular anvils which project beyond the frame a sufficient distance to permit of gaging close to shoulders. This gage is here illustrated. The position of the

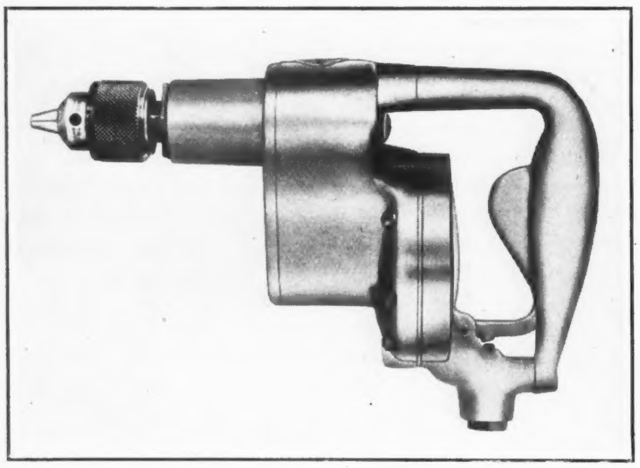


Latest Addition to Line of Adjustable-limit Snap Gages manufactured by the Meldrum-Gabrielson Corporation

two anvils at the top is adjustable, but the long anvil at the bottom has a fixed position. It is, however, possible to remove the lower anvil from the frame. The anvils project a full 1/32 inch beyond the frame.

TURBINE AIR DRILL

A portable No. 2-A "Tiny" air drill driven by a simple turbine weighing about ½ pound and having a capacity for driving ⅜-inch drills through steel and ½-inch drills through wood, has been added to the line of portable air-driven equipment manufactured by the Turbine Air Tool Co., 710 Huron Road, Cleveland, Ohio. The turbine consists of one solid piece and revolves on ball bearings. There is a clearance of 1/32 inch between the turbine and its housing. The features claimed for this drill include light weight, compactness, fewness of parts and wide range of speeds.



No. 2-A "Tiny" Air Drill manufactured by the Turbine Air Tool Co.

* * *

NEW MACHINERY AND TOOLS NOTES

Electric Hoist: Joslyn Mfg. & Supply Co., 3700 S. Morgan St., Chicago, Ill. An electric hoist having a speed-reducing mechanism consisting of three internal ring-gears, three planetary pinions and a high-speed pinion mounted on the motor shaft. This gearing gives a speed reduction of from 100:1 to 350:1 between the driving pinion and the sheave which carries the load. The hoist may be supplied with either a rope or chain lift. With the chain lift, a hook can be used on either end of the chain.

Bench Metal Saw: Triangle Metal Products Corporation, Rochester, N. Y. A bench type saw designed for the rapid cutting of small or medium-sized cold-rolled steel, drill rod, etc. It is built in two sizes, the No. 1 being intended for work from ⅛ to ½ inch in diameter and the No. 2 for work from ½ to 1 inch in diameter. The saws are 1/32 inch thick, are hollow ground to give a clean cut and are interchangeable. The machine is driven by a ⅛ horsepower motor which receives the current from a lamp socket.

Melting Furnace: Johnson Gas Appliance Co., Cedar Rapids, Iowa. A medium-size gas furnace for melting soft metals which has a removable cast-iron pot that will hold 150 pounds of metal. Three patented atmospheric Bunsen burners develop any temperature up to 2250 degrees F. and are said to consume only about 40 cubic feet of gas per hour. Two burners are sufficient for keeping the metal in the molten state. These burners have shut-off valves and pilot lights. The furnace has a direct jet regulator having an orifice that can be instantly adjusted to any pressure or to suit the quality of the gas. It sends a jet of gas up the center of the mixing tube without the use of a forced air blast or blower.

Time-study Machine: H. H. Williams, 1613 Chestnut St., Philadelphia, Pa. A time-study machine in which a strip of paper is moved at a uniform rate of speed and a pen traces a line on the moving strip. This pen is moved back and forth across the paper when the operator presses two finger keys. One of these keys is pressed at the completion of each element of a cycle in an observation. Thus the pen moves by steps across the strip. At the end of the cycle the pen is returned to its starting position by pressing on the second key. The operator can keep his eyes constantly on the workman as it is not necessary to pay close attention to the machine. The length of time between each step of the pen can be determined by means of a scale.

* * *

THE AUTOMOBILE INDUSTRY

According to a report of the Department of Commerce on industrial conditions, about 232,000 automobiles were built during the month of May in addition to 25,000 trucks. June is said to have been the largest producing month in the history of the automobile industry. Ford's June production schedule was 140,000, or a daily average of 5400 cars per working day; orders for June delivery were stated to total 195,000 cars, trucks, and tractors. The shops of the well-known automobiles were going at top speed during the month of June, and the same schedule will be continued at least until the middle of July. Equipment and parts manufacturers have a hard time keeping up with the demand. The tire industry which naturally follows the activity in the automobile industry is fully occupied, and machine shops devoted to the making of tire molds are running at 100 per cent capacity.

The manufacturers of alloy steels, the greater part of which product goes to automobile shops, are running their plants at capacity and one of the plants in this field is turning out 40 per cent greater tonnage than during the peak months in 1920. There is a growing scarcity of steel of all kinds, and deliveries are quoted far ahead. It is expected that there will be a slight reduction in automobile production in the fall, but the total production for the year is likely to be considerably greater than in 1921.

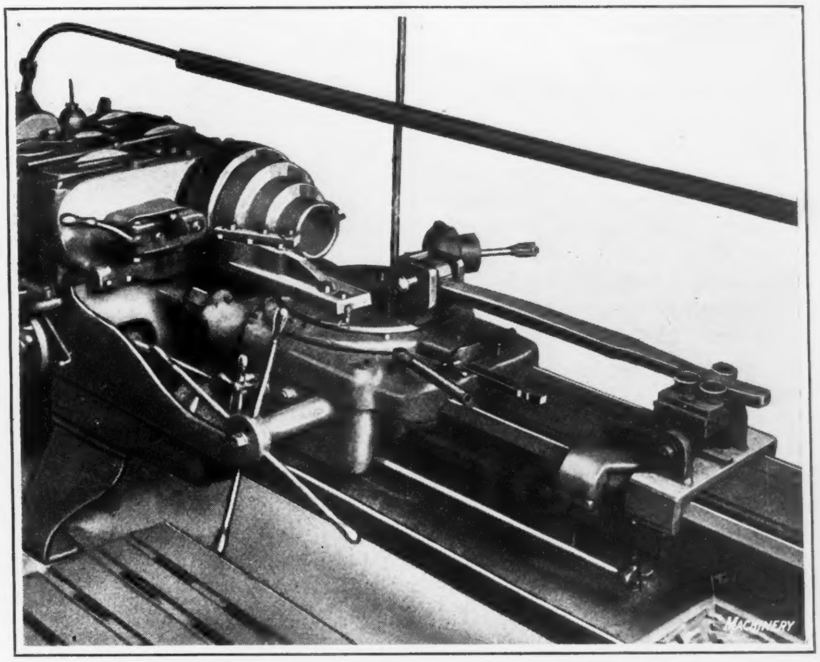
* * *

PULLEY-CROWNING ATTACHMENT

An attachment for crowning step pulleys on a Jones & Lamson flat turret lathe is used by the Valley City Machine Works, Grand Rapids, Mich., where this crowning attachment was developed. In using this device, the turret is released so that it is free to swing on its pivotal support. A bracket attached to the turret carries the cutting tools, there being one for each step on the pulley. A long bar is also attached to the turret, in line with the lathe spindle, the extended end of which has a cam surface that guides the

tools in turning the crowns to the proper form. This forming bar can be tilted back by the withdrawal of two taper pins, leaving the turret clear. Inasmuch as three tools are attached to one bracket, there is, of course, a slight theoretical error in the form of the crowns, because the cam end of the bar can be correct for guiding only one crowning tool. However, the errors are insignificant, and do not affect the efficiency of the pulley.

The operation of the attachment is extremely simple. As the tools are fed across the work, in traversing the carriage longitudinally, the cam end of the bar is guided by three rollers between which it operates. This causes the turret to pivot and thus enables the tools to generate the desired crown on the pulley steps. The rollers are attached to a fixed bracket fastened to the ways of the lathe. The curvature of the cam surface is greater than that of the crown, the difference being proportionate to the radial lengths between the center of the turret and the cam-rolls, on the one hand, and the center of the turret and one tool on the other.



Turret Lathe with Cam-controlled Pulley-crowning Attachment

A device of the same general design as that illustrated is employed in this shop for taper-turning operations. The taper-turning attachment also has a cam-bar, the end of which is inclined to correspond with the taper desired on the work.

* * *

MEETING OF AUTOMOTIVE ENGINEERS

The society of Automotive Engineers held its summer convention at White Sulphur Springs, June 20 to 24. The entire first day was devoted to reports and discussion of the Standards Committee. During the following days special sessions were devoted to research, passenger cars, fuel and engines, aeronautics and motor buses. Mechanical problems were considered in papers by G. E. A. Hallett on "Methods of Developing Aircraft Engines"; by P. M. Held on "Overhead Camshaft Passenger Car Engines"; and by H. M. Crane on "A New System of Spring Suspension for Automotive Vehicles."

* * *

MEETING OF AMERICAN RAILROAD ASSOCIATION

The annual meeting of the American Railroad Association was held in Atlantic City, June 14-21. The mechanical division held its sessions during the first three days of the meeting. Reports were presented by the various committees on the cost of labor and materials; arbitration; tank cars; loading rules; train lighting and equipment; car construction; couplers and draft gears; brake shoe and brake beam equipment; train brake and signal equipment; and car wheels. Saturday, June 17, was set apart for viewing the exhibits which were unusually complete this year. There were in all about 350 exhibitors, and about 100,000 square feet was devoted to exhibit space. Among the exhibitors there were over fifty in the machine tool, small tool, and shop equipment field. The committee in charge of exhibits was complimented upon the care that had been taken in having the exhibits ready at the beginning of the convention. The scope of the exhibits was doubtless the largest of any that has been held in connection with the Railway Association conventions. In addition to machine tools and shop equipment, practically all kinds of railway equipment were exhibited, from complete locomotives and cars to the small devices used in the construction of railway rolling stock. Every square foot of space in the machinery hall on the pier was used by manufacturers of machinery and tools, and the machine tool exhibit was without question the most complete that has ever been assembled for any exhibition of comparatively short duration. A great many of the machines shown were operated during the exhibit, and many of the machine tool builders showed a number of their new developments for the first time.

* * *

AMERICAN MACHINE TOOLS AT BRUSSELS FAIR

An interesting exhibit at the Brussels Fair, consisting principally of American machine tools, is shown by the accompanying illustration. Henri Benedictus of Brussels was the exhibitor, and the American machine tools included a Pratt & Whitney tool-room lathe and a vertical shaper; a LeBlond lathe and a milling machine; a Norton grinding machine; a Heald grinding machine; and a Stockbridge shaper. These machines were arranged for belt drive in order to provide actual demonstration. In addition, the exhibit included various forms of Norton grinding wheels, a variety of small tools from Pratt & Whitney, and files from Henry Disston & Sons, Inc.

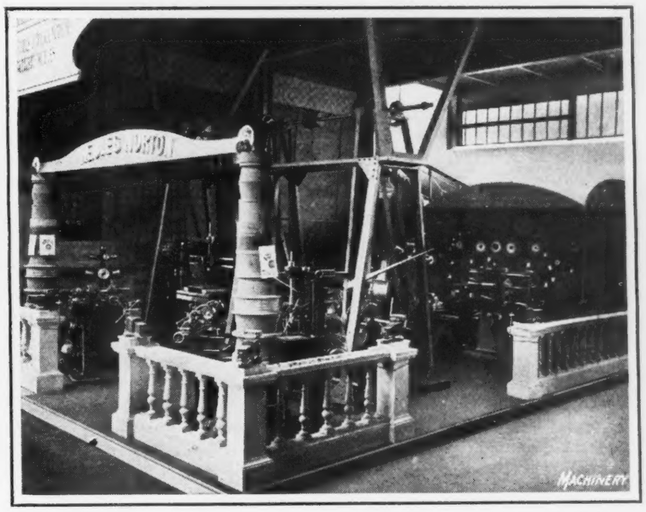


Exhibit of Henri Benedictus at Brussels Fair

CONSOLIDATED MACHINE TOOL CORPORATION OF AMERICA

The consolidation of five machine tool companies into a combination known as the Consolidated Machine Tool Corporation of America is announced. The new company is incorporated in Delaware, with a capitalization of $10,000,000 preferred stock, and 200,000 shares of common stock of no par value. The general offices of the company will be at 17 East 42nd St., New York City.

The merger includes the following well-known companies in the machine-tool building field: Newton Machine Tool Works, Inc., Philadelphia, Pa.; Hilles & Jones, Wilmington, Del.; Betts Machine Co., Rochester, N. Y.; Colburn Machine Tool Co., Cleveland, Ohio; and Modern Tool Co., Erie, Pa. Conferences to arrange for the consolidation have been in progress for about a year.

The officers of the new corporation have not yet been announced, but it is understood that W. H. Marshall is slated for chairman of the board of directors, and C. K. Lassiter for president. Mr. Marshall is a former president of the American Locomotive Works, and Mr. Lassiter was formerly vice-president of that company.

* * *

PERSONALS

R. P. Volkmer, formerly purchasing agent for the Tate-Jones Co., of Pittsburg, Pa., industrial furnace engineers, is now connected with the Colonial Steel Co. of Pittsburg as Cleveland representative.

William J. Merten, metallurgical engineer of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been elected vice-chairman of the Pittsburg chapter of the American Society for Steel Treating.

Tobias Dantzig, formerly research engineer of S K F Industries, Inc., has opened an office at 1109 Canadian Pacific Bldg., New York City, to engage in scientific and technical consulting work. He will specialize in bearing problems and mathematical research of an engineering nature.

Ralph Templeton, for several years manager of the Whitman & Barnes Mfg. Co.'s New York office and store, assumed an important position in the company's executive offices in Akron, Ohio, on July 1. Mr. Templeton first entered the employ of the Whitman & Barnes organization in 1898, and has served it in various capacities continuously since that time. After demonstrating marked ability in the Akron office and as Detroit representative, he was appointed manager of the New York store in 1910.

John F. Schurch has been elected a vice-president of Manning, Maxwell & Moore, Inc., New York City, and has been placed in charge of western sales, with headquarters at the company's Chicago office, 27-29 N. Jefferson St. Mr. Schurch is a graduate of the University of Minnesota, and was connected for several years with the Minneapolis, St. Paul & Sault Sainte Marie Railroad. Later he became associated with the Railway Materials Co. of Chicago. In 1914 he was elected vice-president of the T. H. Symington Co., of New York.

Tillman D. Lynch, metallurgical engineer with the Westinghouse Electric & Mfg. Co., has been nominated for the presidency of the American Society for Steel Treating. Mr. Lynch is a graduate of the University of Virginia. He has been with the Westinghouse Electric & Mfg. Co. since 1899, holding various positions, among them inspector of materials, engineer of tests, section engineer in charge of manufaturing processes, and metallurgical engineer. He is the author of a number of technical papers read before various societies, and published in the technical press.

Harry M. Wey has been appointed manager of the Chicago district for the Pittsburg Testing Laboratory, with headquarters at 1560 Monadnock Block. Mr. Wey was previously connected with the Pennsylvania Railroad, holding the office of superintendent of motive power at Columbus, Ohio, and later was associated with the Illinois Central and the Atchison, Topeka & Santa Fe Railroads. From 1905 until 1909 he was in the mechanical department of the Pennsylvania Lines west of Pittsburg, after which he entered the sales department of the United States Metallic Packing Co.

J. J. Gibson, manager of the supply sales department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been made assistant to the vice-president. In his new position Mr. Gibson will have general supervision over the activities of both the supply sales department and the recently established merchandising sales department. He has been associated with the company for over twenty years. From 1900 to 1905 he was connected with the Chicago office, after which he was sent to Philadelphia. He was appointed district manager of the Philadelphia district in 1906, and in 1914 was promoted to the managership of the supply department at East Pittsburg.

Samuel T. Freas, of Henry Disston & Sons, Inc., Philadelphia, Pa., has been awarded the Edward Longstreth medal by the Franklin Institute in recognition of his invention of the interlocking tooth metal-cutting saw. This medal is awarded by the Franklin Institute on recommendation of the Committee on the Sciences and the Arts for "inventions of high order, and for particularly meritorious improvements and developments in machines and mechanical processes." Mr. Freas has been asssociated with Henry Disston & Sons, Inc., for the last twenty-one years. The saw for which he was awarded the medal was designed and developed by him in the Disston factory, and is manufactured as a standard Disston product.

Frank W. Oliver has become connected with the sales organization of the Whitman & Barnes Mfg. Co., Akron, Ohio. Beginning July 10 he will become eastern sales manager of the company, with headquarters at the New York store, 64 Reade St. Mr. Oliver has been connected with the drill and reamer industries since 1899, when he became a salesman for one of the twist drill manufacturers, and for six years he covered the United States and Canada for this concern. In 1905 he became associated with another well-known company in the same field as representative in the Chicago territory. For fifteen years he remained with this corporation, being district manager in charge of western sales for six years.

Joseph F. Keller, vice-president of the Keller Mechanical Engraving Co., of Brooklyn, N. Y., has been awarded the Edward Longstreth Medal of Merit for Invention, in consideration of substantial improvements and inventions made by him in the art of mechanical die cutting, as represented in the Keller automatic die-cutting machine of the reproducing type. The citation accompanying the medal was in part as follows: "The Institute believes credit should be given to Mr. J. F. Keller for having met a recognized need for increasing die production and reproduction over that which was possible by the old hand method and skilled operators. His efforts have resulted in quicker and better production by less skillful operators and a reduction of the costs."

W. E. Whiting is now associated with the Greenfield Tap & Die Corporation, Greenfield, Mass., representing the machine tool division of the company. He will specialize on the "Hydroil" internal grinder of this company's manufacture, which has been recently placed on the market. His headquarters will be at 2990 Concord Ave., Detroit, Mich. Mr. Whiting has been connected with the grinding industry for fourteen years. From 1909 to 1916 he was with the Heald Machine Co. of Worcester, Mass., serving as apprentice, journeyman grinder, demonstrator, and finally as superintendent of the grinding department. In 1916 he went with the Norton Co., doing laboratory and demonstration work for a short time. For the last four years he has been handling sales for the grinding wheel division of the Norton Co. in Michigan, and is therefore well known in that territory.

William H. Eager, since 1918 first vice-president of the Whitman & Barnes Mfg. Co., Akron, Ohio, has been made president of that organization to succeed A. D. Armitage, who has resigned in order to give more of his time to his duties as vice-president and general manager of the J. H. Williams Co. Mr. Eager is a graduate of the Massachusetts Institute of Technology, and for the last sixteen years he has been with the Whitman & Barnes Mfg. Co. At first he was assistant superintendent of the Chicago factory, and later became works manager. In 1908 he was elected treasurer, and in 1909 he was transferred to Akron when the executive offices were removed to that city. In 1911 he was made sales manager, and was elected first vice-president in 1918. Mr. Armitage, whom he succeeds as president, will still remain a member of the Whitman & Barnes Mfg. Co.'s board of directors.

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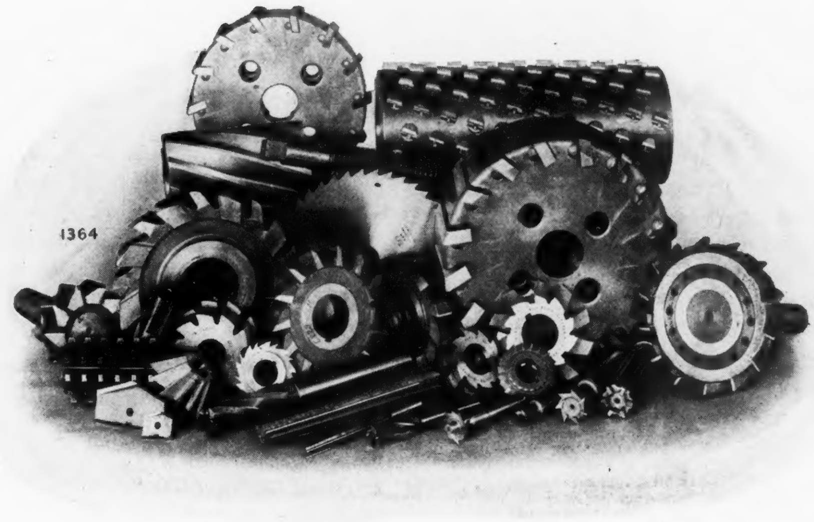
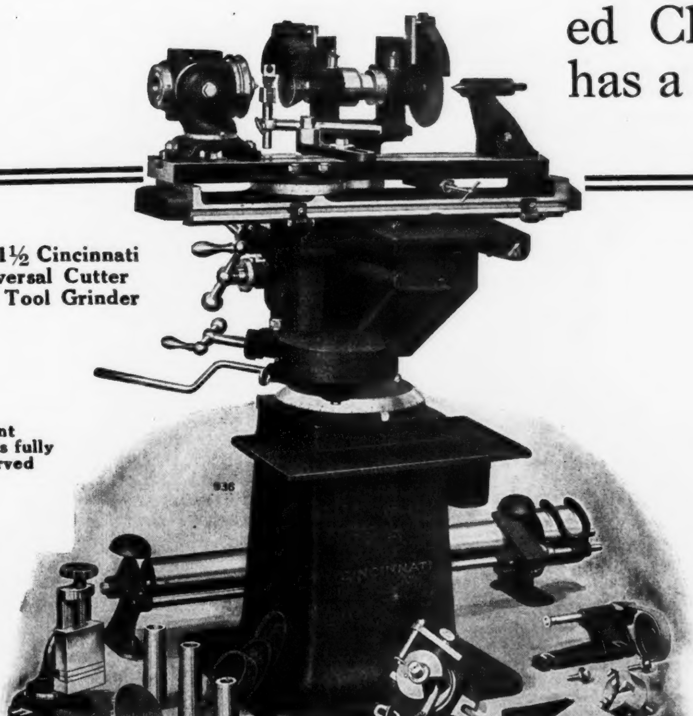
OBITUARY

Benjamin Hiel Bristol, for many years president of the Bristol Co., Waterbury, Conn., died at his home in Platts Mills, May 25. Mr. Bristol was badly injured when hit by a trolley car last July, and never fully recovered from his injuries. He was born in Naugatuck in 1837, and was in the employ of the Platts Mill Co. for forty years. In 1889 he assisted in organizing the Bristol Co., and was its president until a few years ago.



Any cutter in the pile

can be quickly and correctly sharpened on the Cincinnati Cutter Grinder. The Patented Clearance Setting Dial has a lot to do with it.



No. 1½ Cincinnati Universal Cutter and Tool Grinder

Patent rights fully reserved

This machine takes work 10-in. diameter, 17 in. long. Has 11-in. table travel—9½ in. cross and 7 in. vertical. Will grind High Power Face Mills up to 12 in. in diameter and Standard Face Mills up to 16 in. diameter; formed cutters up to 5½ in. diameter, using a 4-in. diameter grinding wheel.

It is no trouble at all to grind correct clearances with the Cincinnati Patented Cutter Clearance Setting Dial. No clearance tables or diagrams are needed.

This is a big feature in the Cincinnati Cutter Grinder—no other grinder has it.

There are many other exclusive features, helping to increase production in hundreds of shops. *Let us give the full details.*

The Cincinnati Milling Machine Company

CINCINNATI, OHIO, U. S. A.

PROPOSED REDUCTION IN SECOND-CLASS POSTAGE RATES

A reduction in the second-class postage rates, which were originally imposed as war taxes but which have since been retained, is provided for in a bill which was introduced in the House of Representatives by Representative M. Clyde Kelly of Pennsylvania. This bill proposes to repeal the last two of the four increases in postal rates which have been made under the war revenue law of 1917. It is pointed out in a statement by Mr. Kelly that the publishers of periodicals are in need of this relief from discriminatory war taxation in order that they may be able to continue to serve the public effectively. The rates that would be established in accordance with Mr. Kelly's bill would still be 175 per cent higher than the pre-war rates; the present rates are 325 per cent higher than pre-war rates.

Educational periodicals, in particular, should not be taxed for revenue purposes, but should be expected merely to pay for the service rendered in carrying this class of mail matter. The fact that the higher rates are charged on the advertising pages does not lessen the injustice. Advertising is not merely merchandise, but information. Mechanical periodicals are information highways, just as essential to business prosperity as are regular highways and waterways. The advertisements in mechanical periodicals are the chronicles of every advance in industrial achievement, and without them the publication of the educational information in magazines would be impossible.

COMING EVENTS

August 28-September 2—Annual Safety Congress of the National Safety Council in Detroit, Mich. Secretary S. J. Williams, 168 N. Michigan Ave., Chicago, Ill.

September 11-16—Eighth national exposition of chemical industries in the Grand Central Palace, New York City. Managers, Charles F. Roth and Fred W. Payne, Grand Central Palace, 46th St. and Lexington Ave., New York City.

October 2-7—Annual convention and exposition of the American Society for Steel Treating in Detroit, Mich., General Motors Bldg. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

December 7-13—National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City. Charles F. Roth, manager, Grand Central Palace, 46th St. and Lexington Ave., New York.

NEW BOOKS AND PAMPHLETS

Thermal Stresses in Chilled Iron Car Wheels. By G. K. Burgess and R. W. Woodward, 34 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 209 of the Bureau of Standards. Price, 5 cents.

Graphic Comparison of Screw-thread Pitches. Chart published by the Department of Commerce, Washington, D. C., as Miscellaneous Publication No. 49 of the Bureau of Standards.

The chart shows the number of threads per inch and pitch in millimeters for both inch and millimeter systems, and comprises a graphical determination of the relation between English and metric screw-thread pitches.

The A B C of Vacuum Tubes in Radio Reception. By E. H. Lewis. 132 pages, 5 by 7½ inches. Published by the Norman W. Henley Publishing Co., New York City. Price, $1.

This is an elementary book describing in simple language the theory and operation of the vacuum tube in a radio receiving circuit. It is written especially for beginners who know nothing about radio and very little about electricity, no previous technical knowledge being necessary to understand it. Starting with an explanation of elementary electrical terms and a list of symbols, the functioning of various vacuum tubes as detectors and amplifiers is explained step by step in a simple manner. The subject of speech distortion is discussed and its elimination explained. A section of questions and answers is included, which gives information for those who are contemplating the installation of receiving equipment or who are getting unsatisfactory results with their equipment.

Publicity Methods for Engineers. 207 pages, 5 by 7½ inches. Published by the American Association of Engineers, 63 E. Adams St., Chicago, Ill. Price, $1.50.

The purpose of this book is to make plain the principles of presenting to the public information about engineers, and to show how this is being accomplished. The book is based on the talks and discussions at the First National Engineering Conference on Public Information held by the American Association of Engineers in Chicago in 1921. It has been carefully edited to conserve the time of the reader and amended to form a working manual of modern public information methods used by associations, municipalities, public service corporations, and trade organizations in promoting favorable public opinion. The contents include five chapters covering the following subjects: Some Reasons for Publicity; the Right Conception of Publicity; Ways and Means that Bring Publicity; Getting News in the Newspapers, and the Publicity Man and what he Needs to Know.

The Gantt Chart. By Wallace Clark. 157 pages, 6 by 9 inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price 2.50.

In these times, when the problem of decreasing costs and increasing production is of vital importance to all executives and engineers responsible for production control, books dealing with different phases of scientific management are of particular interest. The book under review is a valuable addition to this class. It describes the principles and methods of construction of the Gantt management chart. The purpose of the chart is to enable work to be readily planned for a whole plant or an entire industry, so as to make the best use of available equipment and to get work done when it is wanted. The construction is such that information can be concentrated in a single sheet which would require a large number of sheets, if the usual type of curve sheets were used. The ways in which these charts have been applied are described, and all the types of charts thus far developed are explained. These include the machine record chart, the man record chart, the lay-out chart, the load chart, and the progress chart. The field of application of these carts is almost unlimited; besides their use in connection with manufacturing operations, they may also be used for office work, sales quotations, stores keeping, budgeting, and other activities.

Machine Shop Work. Pamphlet published by the Bureau of Education of the United States Department of the Interior, Washington, D. C. Sent free on application.

This little pamphlet contains an outline of a reading course on machine shop work, including electric and oxy-acetylene welding, prepared by the American Library Association for the Bureau of Education of the United States Department of the Interior. This pamphlet points out that mechanical drawing and mathematics are foundation studies for shop practice, and that the machinist who can read drawings, solve shop problems, and make calculations is making his services more valuable than the man who must always ask questions. The shop man should also know as thoroughly as possible, not only the operation of his own machine, but of other machines and tools used in the machine shop. It is not enough to learn by one's own experience, but one should also learn and profit by the experience of others. By studying books, it is possible to find short-cuts, avoid mistakes, and get a new understanding and a new interest in the daily task, all of which will ultimately lead to greater success. The reading course outlined contains twenty-four books, covering mechanical drawing, general shop practice, turning and boring, drilling, gear-cutting, milling, automatic screw machine work, planing and milling, die-making and die design, electric welding, and oxy-acetylene welding.

Principles of Bearings. By Louis Langhaar. 125 pages, 7 by 9 inches; 55 illustrations. Published by the Langhaar Ball Bearing Co., Aurora, Ind. Price, $2.

The purpose of this book is to present and clarify the basic principles of bearings. It resolves bearings into their elementary types, and then dissects these types, showing the few elementary principles which govern each. The five principal objects in the selection of a bearing, it is pointed out, are reliability, durability, accomplishment of a definite result, the carrying of a definite load at the lowest costs per year, per pound, or per mile—all things considered—and the attainment of the greatest carrying capacity with the least weight and bulk. The book first briefly considers plain bearings, and then gives more extended treatment to ball and roller bearings, the former being dealt with completely. In covering ball bearings, the author first deals with the evolution of ball bearings, and follows his treatment with special chapters on radial bearings, the strength of raceways, the assembling of radial bearings, thrust bearings, three- and four-point contact bearings, two-point angular contact bearings, adjustable bearings, and two-row ball bearings. Stribeck's formulas for load are dealt with, and the lubrication of ball bearings is thoroughly covered. Separate consideration is given to ball separators, material and workmanship, vibration and noise of bearings, the fitting of ball bearings on shafts and in housings, proper construction of raceways, and durability of bearings. It will be noted from this review of the contents that this book deals with all the varied problems that have been met with in ball bearing design since the early developments of the ball bearing industry. Those interested in ball bearings, as manufacturers, designers, or users will doubtless find much of interest in this book. It covers the subject both from a theoretical and a practical point of view. In referring to the fact that mathematics cannot be avoided in a proper mechanical analysis, the author states that he has made an effort to have the mathematics in this book simple and clear, bearing in mind one of the best definitions given for mathematics: "Mathematics is applied common sense."

NEW CATALOGUES AND CIRCULARS

Edison Lamp Works of General Electric Co., Harrison, N. J. Bulletin 102-A of the Lighting Data series, treating of the effect of color of walls and ceilings on resultant illumination.

Monitor Controller Co., Baltimore, Md. Circular illustrating the Monitor "Thermaload" starter, which is suitable for any size motor from the smallest up to 10 horsepower, 220 volts, two or three phase.

Paragon Machine Co., Rochester, N. Y. Circular describing Paragon blueprinting and print-drying machines. The construction of these machines is described in detail and the distinctive features are pointed out.

Watts Bros. Tool Works, Turtle Creek, Pa. Catalogue 5, illustrating and describing this company's line of square and hexagon hole drilling tools, and giving data on the saving in production costs of drilling these holes in steel, etc.

Barnhart Bros. & Spindler, Monroe and Throop Sts., Chicago, Ill. Circular descriptive of the characteristics, physical properties, and ingredients of "Tenso" die-castings. A large number of parts for which this alloy is suitable are shown.

American Spiral Pipe Works, Chicago, Ill. Circular illustrating the large variety of spiral pipe fittings produced by this concern. These fittings are furnished for all sizes of pipe from 3-inch light spiral pipe to 96-inch forge-welded pipe, 1½ inches thick.

Roeper Crane & Hoist Works, 1720 N. 10th St., Reading, Pa. Catalogue 52, containing descriptive material and tables of capacities, dimensions, and prices of Roeper I-beam trolleys, chain hoists, switches, and turntables for the overhead handling and conveying of materials.

Christiana Machine Co., Christiana, Pa. Catalogue 101, containing tabular matter covering the dimensions, horsepower transmitted, prices, etc., of the line of cast-iron spur gears, miter gears, bevel gears, spur mortise gears and pinions, worms and worm-gears, etc., made by this concern.

Thwing Instrument Co., 3339 Lexington Ave., Philadelphia, Pa. Bulletin 11, describing Thwing radiation pyrometers of the indexing and multiple-recording types, for measuring temperatures in heat-treating furnaces, coke ovens, etc., and for measuring local temperatures of dies in hardening furnaces.

Wagner Electric Mfg. Co., St. Louis, Mo., manufacturer of motors and other electric equipment, has issued a calendar for May 1922—May 1923, inclusive, designed to show three months at a glance. On each sheet is printed a brief statement of the characteristics and uses of Wagner "Pow-R-full" motors.

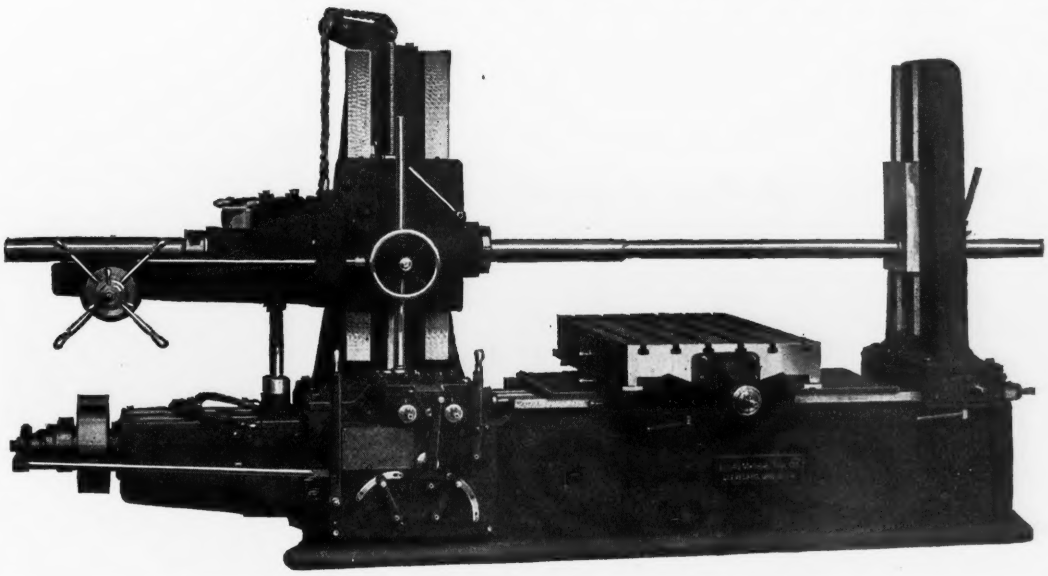
Condensite Co. of America, Bloomfield, N. J. Circular descriptive of the plastic molding of condensite, describing in detail how this material is molded, and the design of the molds used. The properties of condensite are explained at length. Circular containing a list of the products made by this company.

Hanson Tool & Die Co., Detroit, Mich. Catalogue containing illustrations and tables of dimensions and prices, covering the line of "West" tools made by this concern, which includes tool-

Distance lends enchantment to—lots of things but NOT to the

"PRECISION"

Boring, Drilling and MILLING MACHINE



The closer you get, and the more you know it, the better you like it; it has no tricks to plague you either before or after you get familiar with it, which does not take long, because

IT IS SIMPLE

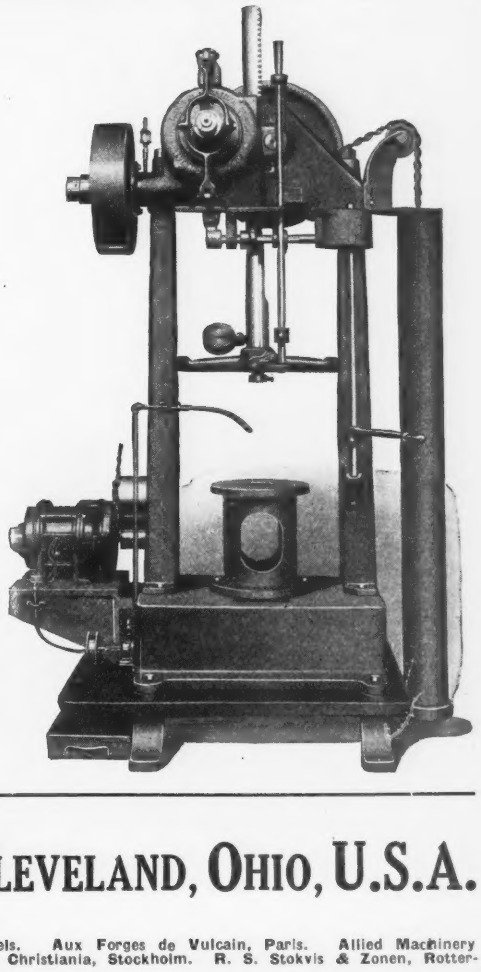
Almost like SLEIGHT OF HAND is the ease and quickness with which our new

Vertical Push-Broaching Machine

handles the broach.

"A SIMPLE TWIST OF THE WRIST" DOES THE TRICK

Less floor space—More production



LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anoyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Company, Turin, Barcelona, Zurich. Benson Brothers, Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Company, Tokyo, Japan.

holders, connecting-rod tools, end-mills and keyway cutters, counterbores and countersinks, drills, face and side milling cutters, and reamers.

E. J. Codd Co., 700 S. Caroline St., Baltimore, Md. Circular descriptive of the Wiegand chain furnace screens for oven and furnace openings, which are designed in such a way as not to interfere with the free manipulation of the tools required to handle the charge and at the same time to keep the heat in and the cold air out.

Erie Foundry Co., Erie, Pa. Bulletin 90, containing descriptive material and illustrations of Erie sheet galvanizing equipment, squaring shears, and sheet levelers. The Erie sheet galvanizing machine is designed for galvanizing flat sheets of all standard sizes and gages, and it is arranged for either belt or motor drive.

Pannier Bros. Stamp Co., 207 Sandusky St., Pittsburg, Pa. Circular illustrating the line of marking equipment made by this concern for marking trademarks, company names, or other data, on sheets, plates, and structural material. These markers are made with interchangeable rubber dies which can be quickly attached and removed.

Cooper Hewitt Electric Co., 95 River St., Hoboken, N. J., is publishing a series of pamphlets known as "Industrial Lighting Briefs" which will appear from time to time and will deal with important phases of the subject of lighting. Those who are interested in industrial lighting will be placed on the mailing list to receive copies, upon application.

Roller-Smith Co., 233 Broadway, New York City. Bulletin 560, illustrating and describing Roller-Smith enclosed circuit breakers, Types E and P. Bulletin 820, descriptive of Roller-Smith PV ammeters and voltmeters and COD indicators for automotive vehicles, farm lighting plants, battery charging outfits, small panels, and similar applications.

Crescent Pump Co., 743 Beaubien St., Detroit, Mich. Description of Crescent vacuum tools, in which application is made of vacuum for chucking flat materials and for handling and lifting flat materials of all kinds, the principle of operation being similar to that of magnetic tools. The tools shown include vacuum chucks, bench blocks, hand lifters, suction cups, oldman, and rivet hold-on.

Niagara Machine & Tool Works, 637 Northland Ave., Buffalo, N. Y. Bulletin containing instructions for the proper care of squaring shear knives. It tells what tests should be applied to the shears, and describes methods of attaching the knives, adjustment, and regrinding of the knives. The bulletin is printed on a large sized sheet, which is intended to be tacked up near the shear.

Ajax Flexible Coupling Co., Westfield, N. Y. Leaflet descriptive of Ajax flexible shaft couplings, which are made in various sizes of bores and types of driving connections for all kinds of service. The construction of the coupling is illustrated by a line engraving, and a table is included giving the dimensions and prices of the different sizes of heavy- and light-duty couplings.

MacGovern & Co., Inc., 114 Liberty St., New York City. Catalogue 51, covering the line of power machinery and contractors' equipment handled by this company, which includes turbines, motors, gas engines and oil engines, generators, converters, air compressors, centrifugal pumps, boilers, condensers, cranes and derricks, etc. The equipment listed and classified in this catalogue is ready for immediate shipment.

Hisey-Wolf Machine Co., Cincinnati, Ohio. Leaflet 3020, descriptive of Hisey electric tools, including ball bearing portable grinders and buffers, ball bearing buffing lathes, heavy-duty portable drills and reamers, toolpost grinders with combination bearings, internal and external grinders, parallel or angle-plate grinders, ball bearing bench and floor grinding machines, bench drilling stand, universal motor drills, and heavy-duty ball bearing grinders.

C. F. Pease Co., 861 N. Franklin St., Chicago, Ill. Catalogue C-61, of American-made drawing instruments, completely illustrating and describing the line manufactured by the company in its Chicago factory. It is pointed out that the manufacture of American-made drawing instruments was developed in this country as a matter of necessity during the war, and that high-grade drawing instruments of American manufacture are now available.

Sabin Machine Co., Cleveland, Ohio. Catalogue A, describing the points of construction of Sabin "one-man" trucks, which are designed for handling open-top steel and wooden barrels or boxes used in foundries, machine shops, stamping works, forge shops, and many other industries. An extension foot-pedal is used on all the trucks except Type S, thus greatly increasing the leverage and eliminating the necessity of helpers for heavy loads. Specifications are given for the various models.

Newark Gear Cutting Machine Co., 69 Prospect St., Newark, N. J. Catalogue 4, descriptive of the Newark No. 2B spur and bevel gear cutting machine, which is designed for the all-around work of machine shops, as well as for manufacturing light and medium work, such as gears used in textile work, automotive work, and special machinery. Specifications are given for this machine, and its application for cutting quill gears, gang cutting, and a number of other jobs is illustrated. Tables of tooth parts are included.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 242, on heat-treatment furnaces, illustrating a variety of methods of applying the principles of proper heating and handling to different manufacturing requirements and shop conditions. The influence of the method of heating and handling on the quality and cost of heat-treated products is pointed out, and information is given on the factors that determine the selection of the proper method. A large number of installations of heat-treating furnaces of the stationary type are shown.

David Lupton's Sons Co., Allegheny Ave. and Tulip St., Philadelphia, Pa. General catalogue 11, containing 191 pages, 8½ by 11 inches, covering the line made by this company, which includes steel sash, casement and double hung windows, rolled steel skylights, roof trusses, corrugated wire glass shelving, bookstacks, and other steel factory equipment. The attempt has been made in preparing this catalogue to make it a comprehensive and up-to-date handbook on the best practices in the use of steel sash, regardless of the make, in all kinds of buildings.

O. S. Walker Co., Inc., Worcester, Mass. Circular W2, descriptive of Walker magnetic chucks of the rectangular, swiveling, and vertical face styles, all of which are of the single coil or single magnet type of construction. Complete descriptions of the different chucks are included, as well as halftone and diagrammatic illustrations which make the construction very clear. Tables of specifications giving the dimensions, size numbers, weights, and electric current used, are included. The use of the Walker improved demagnetizing switch, which is furnished with all these magnetic chucks, is also described.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Circular 1579-B, treating of gears and pinions made of micarta, which is a non-metallic material that may be substituted for steel, cast iron, bronze, and other metals, when a silent drive is desired. The catalogue points out the distinctive features of micarta, and gives the physical and mechanical properties. It describes in detail the manufacture of the gears, including cutting the blanks, turning and drilling, and cutting the teeth. A number of illustrations are shown which give a fair idea of the standard construction that has been recommended and generally adopted for gear and pinion construction. Tables of horsepower ratings of micarta gears are included.

Cleveland Worm & Gear Co., Cleveland, Ohio. Bulletin 1, of Cleveland worm-gear drives, containing general information relating to Cleveland worm-gear reduction units, which are suitable for use in textile machinery, turbines, mining machinery, hoisting and conveying devices, automobiles, elevators, rolling mills, and other industrial drives. Lubrication bulletin for Cleveland worm-gear drives, giving instruction for installation, lubrication, and maintenance. Circular containing suggestions relating to the installation of Cleveland worm-drives. The information given makes it possible to obtain the most economical installation for the particular class of work to be done, the selection of a proper sized unit depending upon the load characteristics and motive power conditions. Circular entitled "The Banks are Demanding Economy," showing a blueprint that gives the horsepower and standard dimensions for Cleveland worm-drives for lineshafts.

TRADE NOTES

Wagner Electric Mfg. Co., St. Louis, Mo., has removed its Salt Lake City office to 313 Dooly Bldg.

Vandyck Churchill Co. has removed its office from the Singer Building to 52 Vesey St., New York City.

Buell, Scheib, Mueller, Inc., is a new concern of consulting and combustion engineers which is located at the Columbia Bank Bldg., Pittsburg, Pa. The company will specialize on fuel economy and conservation, and furnace design.

Perdieu Tool Mfg. Co., Milwaukee, Wis., has taken over the business and factory of the **Meigs-Powell Co.** and will continue the manufacture of calipers, dividers, and other machinists' tools. R. A. Perdieu is president and J. B. Matthews, secretary of the concern.

Diamant Tool & Mfg. Co., Inc., 95 Runyon St., Newark, N. J., has appointed the Cleveland Duplex Machinery Co., Inc., 1224 W. 6th St., Cleveland, Ohio, as exclusive representative for the sale of Diamant standard punch and die sets, in the territory covered by the northeastern section of Ohio.

Fred C. Dickow Machinery Co., for the last fifteen years dealer in new and used machinery and tools, and manufacturer of the Dickow 10-inch universal index-centers, has moved the main office and salesroom of the company from 3504 W. Lake St. to 2105 W. Lake St., Chicago, Ill. The new telephone number is West 1352 J.

American Stamping Co., 5400 Windsor Ave., N. E., Cleveland, Ohio, is a new concern which has been formed to specialize in all kinds of stampings. The general manager is F. W. Vilmar, and the president and works manager is W. E. Gemmill, both of whom were associated for many years with the Parish & Bingham Corporation of Cleveland.

V & O Press Co., Brooklyn, N. Y., has recently purchased additional machine shop equipment and is planning to erect an up-to-date factory on a 7½-acre tract of land which the company owns on Cooper Ave. and Long Island Railroad, Glendale. The present factory on Dry Harbor Road has become inadequate because of the increasing demand for V & O power presses and sheet metal working machinery.

United Alloy Steel Corporation, Canton, Ohio, announces the purchase of the plant of the Canton Sheet Steel Co., which was necessitated by the rapidly increasing volume of its business. The alloy plant has been running at capacity for some time, and as soon as possible the new division will be placed in full operation. The company's iron and steel products are marketed under the trade names of "Toncan" and "U-Loy."

I. B. Williams & Sons, Dover, N. H., manufacturers of leather belting, have announced the establishment of a new department of their business for the manufacture of mill strapping of all kinds. They have equipped the department with special machinery for the manufacture of every type of strapping or leather pieces of special shapes required by manufacturers in any line. T. L. Chapman will have charge of the new department.

Air Reduction Sales Co., 342 Madison Ave., New York City, at a recent meeting of the board of directors elected the following officers: First vice-president, A. R. Ludlow, formerly vice-president in charge of sales; vice-president and secretary, M. W. Randall, formerly secretary; vice-president and operating manager, Herman Van Fleet, formerly chief engineer; vice-president in charge of research and development, Dr. F. J. Metzger.

Cleveland Tractor Co., Cleveland, Ohio, manufacturer of the "Cletrac" tank-type tractor for farm and industrial uses, is to be reorganized as the Allyne-Zeder Motors Co., to manufacture and market a new six-cylinder automobile which is being designed by F. M. Zeder, formerly chief engineer of the Willys Corporation and the Studebaker Corporation. A new corporation subsidiary to the Allyne-Zeder Motors Co. will be organized under the name of the Cleveland Tractor Co., which will continue to market "Cletrac" tractors through the present distribution and dealers.

Kent-Owens Machine Co., Toledo, Ohio, has taken over the **Diamond Alloy Tool Co.**, of St. Louis, Mo., and will in the future manufacture "Diamond Alloy," a cutting metal which is cast accurately to form in permanent molds, and is suitable for tool bits, milling cutters, cut-off blades, slitting saws, counterbores, keyway cutters, inserted blades for milling cutters, reamers, and boring tools. The metal has high wear-resisting qualities; it is tough and hard and yet not brittle. The sales of "Diamond Alloy" will be handled by P. H. Briggs, 1235 W. 9th St., Cleveland, Ohio.

Firth-Sterling Steel Co., McKeesport, Pa., has opened a branch office in Los Angeles, Cal., at 336 E. 3rd St., which will be under the charge of E. S. Jackman & Co. of Chicago, who look after all the business of this company west of Pittsburg. William E. Nelson who has been selling Firth-Sterling steels for twenty years, will have direct charge of the work. The Los Angeles office will carry in stock "Blue Chip" high-speed bits for tool-holders in all standard sizes and both square and beveled styles. Orders for tool and die steel in bars will be filled from the Chicago warehouse or from McKeesport as in the past.

Pittsburg Testing Laboratory has opened a sales office and complete inspection bureau at 1864 Railway Exchange Bldg., St. Louis, Mo. Colonel N. C. Hoyles will be district manager. Colonel Hoyles has been associated with the company for a number of years, having entered the service as inspector at the Birmingham office in 1908. In 1912 he was promoted to the position of manager in the Birmingham office, and in 1914 was transferred to the Vancouver office. At the outbreak of the war he entered the service of the Canadian Army but returned to the Pittsburg Testing Laboratory after the war was over, and has been assistant sales manager at New York and manager at Cincinnati.

Gardner Tap & Die Co., Cleveland, Ohio, has recently been incorporated for the purpose of taking over the business of the **Gardner-Bryan Co.** of Cleveland, manufacturer of taps, dies, and screw plates. F. W. Wood, president of the Wood & Spencer Co. and of the Cleveland Castings Pattern Co., is president of the new company; J. M. Gardner and R. H. Smart of the former Gardner-Bryan Co. are vice-president and sales manager, and treasurer, respectively, and D. G. Miller, secretary of the Wood & Spencer Co. and of the Cleveland Castings Pattern Co., is secretary. The board of directors comprises the officers mentioned and A. K. Spencer, vice-president of the Wood & Spencer Co. and the Cleveland Castings Pattern Co., F. H. Wood of Watertown, Mass., and F. E. Gardner of Beloit, Wis.